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# AMERICAN WATERFOWL

*Their Present Situation  
and the Outlook for  
their Future.*

BY JOHN C. PHILLIPS  
and  
FREDERICK C. LINCOLN



Alma Brooks



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*By John C. Phillips and  
Frederick C. Lincoln*

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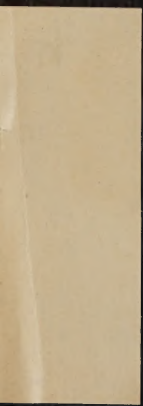
THIS timely and important book discusses the ducks, geese, and swans of North America from the point of view of conservation, confining itself among the ducks to those that are widely hunted for sport. The subjects treated include breeding-areas, wintering-grounds, migration, drainage and irrigation, shooting as an adverse factor in the wild-fowl supply, natural enemies, oil pollution, poisons and diseases, food plants, and methods of hunting, and a final chapter deals with the outlook for conservation and proposes certain policies. There is also an Appendix listing the game wild-fowl of North America with their ranges, the status of the several species, and a record of their body-weights. It is illustrated with maps, drawings by Allen Brooks, headpieces by A. L. Ripley, and a frontispiece in color from an old sporting lithograph.

*Illustrated*

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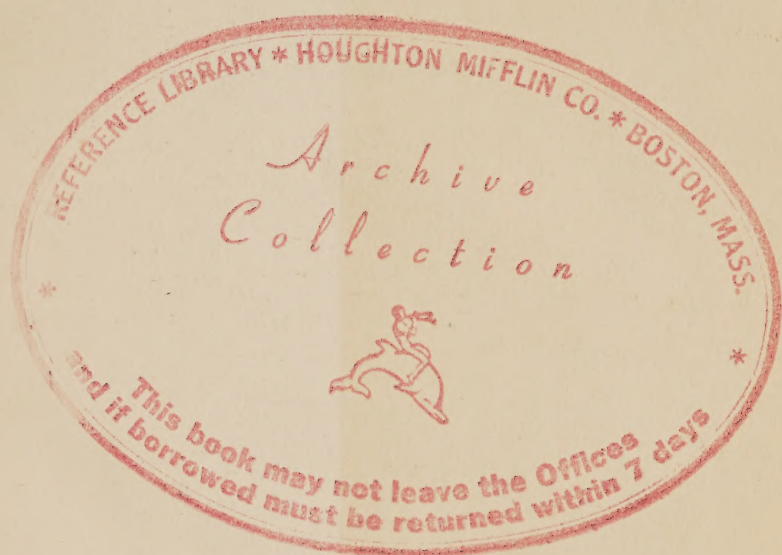












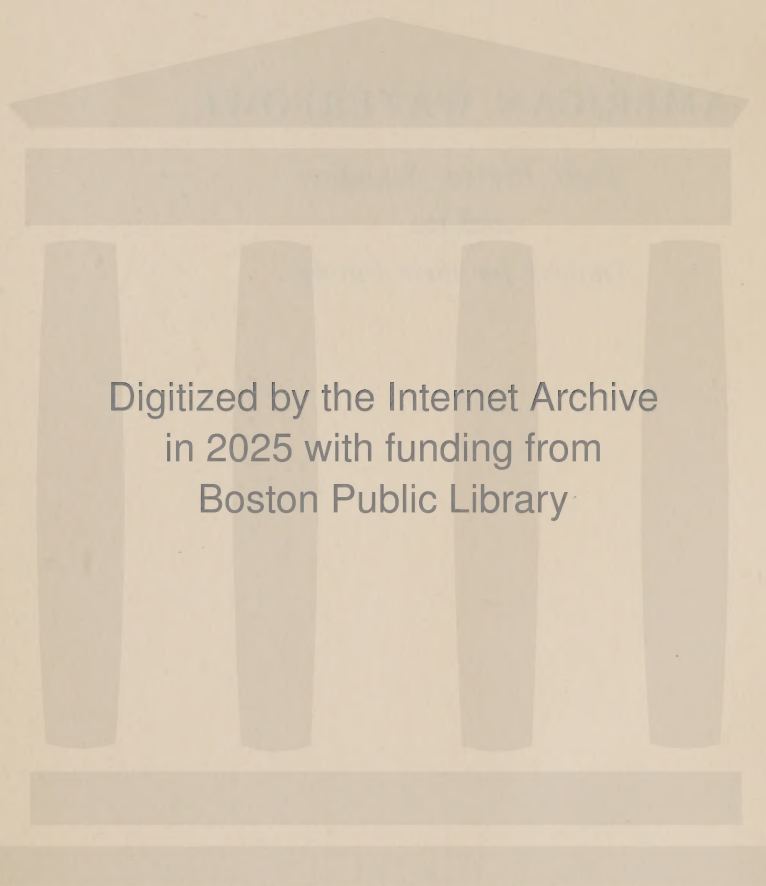






# AMERICAN WATERFOWL

*Their Present Situation  
and the  
Outlook for their Future*



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*Wild Duck Shooting*  
*From a lithograph by N. Currier, 1854*





# AMERICAN WATERFOWL

*Their Present Situation and the Outlook  
for their Future*

BY  
JOHN C. PHILLIPS  
AND  
FREDERICK C. LINCOLN

WITH ILLUSTRATIONS BY  
ALLAN BROOKS AND A. L. RIPLEY



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TO  
EDWARD W. NELSON  
CHIEF OF THE UNITED STATES BIOLOGICAL SURVEY  
1916 TO 1927  
IN RECOGNITION OF HIS MANY YEARS OF SERVICE  
IN THE CAUSE OF AMERICAN WILD LIFE CONSERVATION  
WE DEDICATE THIS VOLUME



## ACKNOWLEDGMENTS

has seen the chapter on 'Conservation.' To all of these reviewers we desire to express our thanks for their comments and constructive criticisms.

We are also indebted to Mr. Paul G. Redington, Chief of the Biological Survey, for friendly advice and coöperation.

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The pictures of waterfowl in flight are from drawings by Allan Brooks.

The headpieces are from drawings by A. L. Ripley.



## INTRODUCTION

WE believe that there is a real need for this work. Much has been written to acquaint the reader with the natural history, appearance, and ranges of the various species of ducks, geese, and swans, but we have approached the subject from an entirely different angle. Considering this great family of birds as a group, and the factors affecting their welfare in the light of national rather than sectional problems, we have tried to call attention to all the new agencies now operating against them.

Unless the more intelligent sportsmen can be made to give serious and immediate attention to the many adverse factors which to-day confront our most valuable wild-fowl, we believe it soon will be too late to save these birds in numbers sufficient to be of any real importance for recreation in the future.

Sportsmen whose seasonal hunts are restricted to a few favorable areas do not appreciate the rapidity of the changes which man has wrought in the face of nature these past few years. It is true that before the World War we made remarkable progress in the conservation of our ducks and geese, chiefly through the cutting off of spring shooting and the stopping of the sale of game. Immediate increase in some species was hailed far and wide as indicating that the dark days were over, and that we could look forward with confidence to a permanent and increasing future supply.

Then came the World War and we had several years

## INTRODUCTION

of greatly reduced shooting, especially in Canada, with less expansion and settlement in the West and Northwest. But by 1920 the tide had begun to turn again, and in the last decade we have seen things come to pass that were scarcely dreamed of twenty years ago. These achievements in the realm of mechanics are too well known to require comment. They have had the immediate effect of bringing the most remote prairie sloughs within a few hours of some railroad or hamlet. The heart of the breeding-grounds for the best of the game ducks is now in the middle of Canada's grain country, and what has happened in our own prairie States will almost certainly follow in the North. It is, indeed, fortunate for us that Canada has set aside in time many valuable lake-lands as sanctuaries and shooting-grounds, and we may be reasonably sure that she will profit by the results of the unwise drainage which she can see on our side of the border.

In spite of all the work of conservationists and all the clamor on the subject of a decreasing game supply, the average sportsman to-day spends at least twenty or thirty times as much on his equipment and his hunting-trips as he does on game restoration. His contribution toward the welfare of the game he shoots is in reality only a meager portion of his small hunting-license fee. So we have this amazing spectacle; that outside of the shooting clubs and private preserves, only five million dollars or less (out of nine and one third million dollars paid in for license fees) are expended on building up a game supply, while around three hundred million dollars are annually spent in helping to destroy it! We have a destructive army of at least two million duck hunters (out of a total number of seven million



## INTRODUCTION

shooters), and we must add to this the army of engineers and industrial generals that are eagerly at work upon our remaining marsh lands and rivers.

We hope that in this book we have made clear the absolute dependence of any one group of sportsmen on some other group, more likely several groups living and shooting perhaps under totally different conditions. If, for example, the Sounds of Currituck and the bays of the Chesapeake fail to furnish winter food, the great west-to-east migrations of our choicest game ducks will fail or go elsewhere, more probably the former calamity. And if the farmers of South Saskatchewan and Alberta decide to capture all the surplus of Red-heads and Canvas-backs before they cross the Canadian border, few will be left for the Atlantic Coast.

We need to have sportsmen grasp the problems discussed herein in a national way rather than in terms of States or Counties. The well-to-do sportsman must be made aware of his responsibility before it is too late to check the unfavorable trend which we see to-day in nearly all our wild-fowl resorts.



# AMERICAN WATERFOWL



## PART I

### OUR WATERFOWL AND THEIR HABITATS







# AMERICAN WATERFOWL



## CHAPTER I

### THE NORTH AMERICAN BREEDING AREAS

SPORTSMEN, unless they happen to be familiar with recent detailed knowledge of Northern breeding grounds have only the haziest sort of notion as to the relative importance of the different regions where wild-fowl nest. They think of Canada as a vast henyard for wild ducks, geese, and swans, extending north from the Canadian Pacific Railroad to the frozen Polar seas, east to Newfoundland, and west to Vancouver Island.

This misconception is the natural outcome, first of a lack of precise information in the many popular books, and second, because the sportsman lacks a real interest in the wild-fowl population as a whole. Once the ducks have left the shooting grounds with which he happens to be familiar, he does not wonder over-

## AMERICAN WATERFOWL

much where they go to, but trusts in that great storehouse, the mysterious Northland, to do his hatching for him when spring comes back.

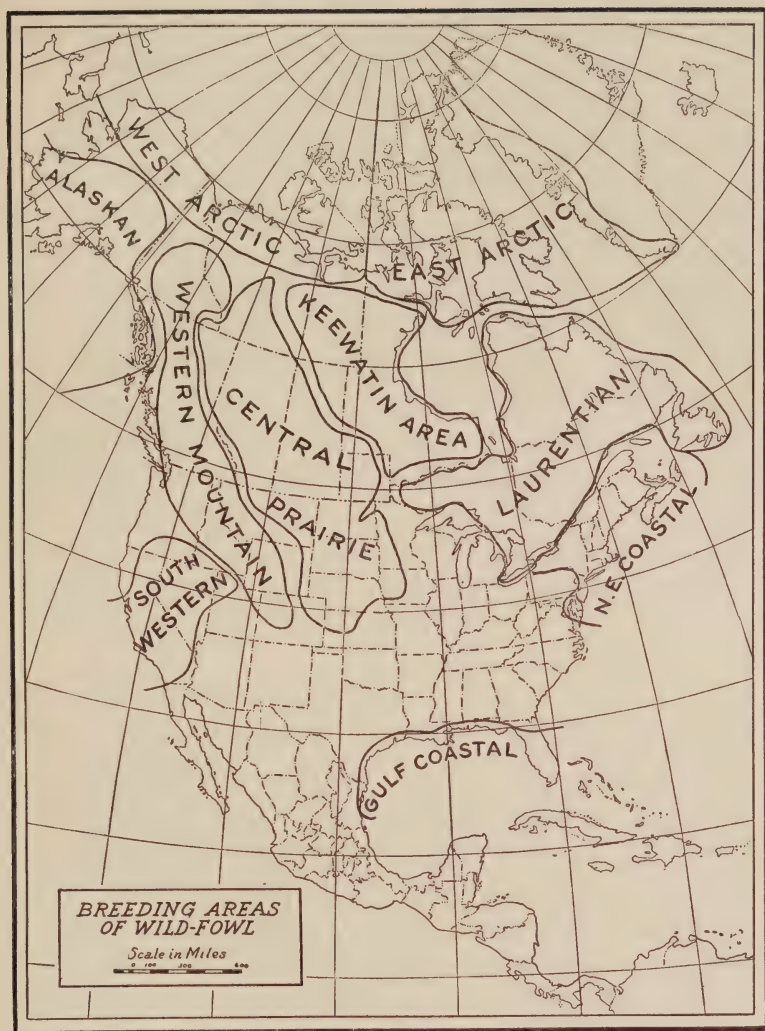
But when one comes to study the breeding grounds in detail, enormous potential differences come to light, and it is from this angle that we wish to treat the subject.

To consider the breeding area as a whole would be an impossible mental task. To take each species separately is outside the scope of this book. So in order to simplify the subject we have prepared a map arbitrarily blocking out certain regions which have something in common, either because of their geographical position, their topography and geology, or because they are favored by certain groups of species of ducks and geese.

It should be noted that these areas have no scientific reason for existence. They are simply arranged for our own convenience.

### *General Considerations:*

In speaking of our game ducks and geese, we of course exclude for the most part the marine ducks, the Scoters and Eiders, the Old Squaw, the Harlequin Duck, and the Golden-eyes. To this list we add the three species of Mergansers, or fish ducks, besides certain geese and ducks that are too rare to have any sporting interest. The term 'game wild-fowl,' therefore, refers to the typical surface-feeding ducks, like the Mallard, Gadwall, Pintail, Teal, and Widgeon, the many diving ducks, like the Canvas-back, Redhead, and Scaups, and the various groups of geese, the Canada group (four species), the Snow Geese (four species), the true Sea Brant (two species), etc.







## BREEDING AREAS

We shall find most of our Northern regions of scant interest to the sportsman who is concerned with the game species alone. One region, however, stands out so far above all others that peculiar emphasis should be placed upon it here and now. This is the great Central Prairie strip extending from near Great Bear Lake in the northwest to the Dakotas and Nebraska in the southeast. Here two thirds to three quarters of the game ducks of the continent nest and rear their young. Not so, however, with the goose tribe, which, except for the Canada Honker, are very far-Northern breeders.

In general the Eastern areas are poor in species; Labrador, once supposed to be the home of many ducks and geese, is almost the poorest of all. The Arctic regions and most of Alaska are chiefly the home of geese, swans, and the far-Northern breeding eiders and other marine ducks, though here and there, especially in the West Arctic and in West Alaska are many Pintail, Widgeon, and Greater Scaup.

### *East Arctic Division:*

This area we have shown extending from the one hundredth meridian on the west to West Greenland, including all lands north of Hudson Straits. Much of it is very little known, especially the south-central portion. Here apparently breed a few Whistling Swans, but not so many as farther west. Among geese it is probable that all the Blue Geese, with a sprinkling of Lesser Snow, breed in the extreme western part of Baffin Island near Bowman Bay, according to the recent explorations of Mr. J. D. Soper. The Lesser Snow Geese breed to the west of the Nettiilling Lake and also probably in the northern part of the island. Many

## AMERICAN WATERFOWL

Lesser Snow Geese are said to breed also on Southampton Island.

The only known breeding range of the Greater Snow Goose was northern Greenland (McCormick Bay, lat.  $77^{\circ} 40'$ , and North Star Bay), but now we know it breeds in northern Baffin Land and probably in other regions. All these Greater Snow Geese (some ten thousand) winter on the Atlantic Coast sand dunes between Virginia Beach and Cape Hatteras.

The Eastern or White-bellied Brant is the same species which occurs in Europe and Western Asia. All the birds of this species which appear on our Atlantic Coast come from the eastern Arctic or northern Greenland. They breed so far north among the Arctic islands that very little is known about them or the conditions that surround them. We do know that during certain seasons very few young birds appear on our coasts. The one hundredth or one hundred and tenth meridian roughly divides this Eastern species from the Black Brant of the Pacific Coast.

Outside of the above-named species probably no 'game wild-fowl' are found in this area, except a few Hutchins Geese. Some very small examples of Hutchins Geese from Southampton Island suggest the presence of a possible race of dwarf Canada Goose in this region. This eastern Arctic is the home of many Eiders, Old Squaws, and a few Red-breasted Mergansers.

All these lands are barren and ill-suited to any waterfowl except those with marine habits; nevertheless, the Snow Geese and the Brant are able to exist on food obtained for a short season on inland pools. There are said to be areas of Silurian rocks in parts of Baffin Island and on Southampton Island which may account

## BREEDING AREAS

there for more favorable feeding lakes and less rugged topography.

Greenland is of no special interest from the point of view of a 'game wild-fowl' supply. Most of the American game ducks which are taken there are stragglers purely and simply. The Greenland Mallard is a distinct race slightly different from the common Mallard, and it does not ever leave the southern regions of the West Coast. It is a scarce bird at best.

Our East Arctic Division remains very much as it always was in so far as game water-fowl are concerned, leaving out of account the destruction of Eiders. The native Eskimo tribes are certainly fewer in numbers than they used to be, but they are better armed. We do not know how many Lesser Snow Geese are killed in summer, but on the Peary Expedition of 1896 we were informed that natives did make summer hunts into the great Nettilling Lake from the head of Cumberland Gulf. Nowadays Eskimos do not make this hunt, according to Mr. Soper.

It would be a pleasant task here to give some space to that host of mighty explorers who pushed their way into the North in the past one hundred and fifty years and continually added to our knowledge of the natural history, from Alexander Light and Samuel Hearne in the middle of the eighteenth century to Sir John Franklin (1819), Edward Parry and John Ross (1819-33), Captain Back (1833), John Rae (1846), and many others down to the present time. But we cannot touch the subject of Arctic voyages.

### *Laurentian:*

This somewhat natural division embraces all the

## AMERICAN WATERFOWL

country north of the Great Lakes and St. Lawrence River and east of Hudson Bay, including Newfoundland. We have carried this area west as far as the border of Manitoba and north to the Albany River. It is a region of small interest to the wild-fowler, formed as it is mostly from gneiss and plutonic rocks, which means as a general rule rough country, swift, clear rivers, and very few shallow lakes and marshes.

Labrador itself is the true home of only two 'sporting' wild-fowl, the Black Duck and Canada Goose, and these are more numerous in the southern part. It is possible, though doubtful, that a few Hutchins Geese may breed here and there north of the tree line, and a few Green-winged Teal breed in Southern Labrador.

The great forested regions of Ontario are remarkable only for their lack of water-birds; a few Black Ducks, Golden-eyes, and many Mergansers of three species being about all that the canoeist will meet. One may travel for days along the great tributaries to James Bay without seeing any water-birds to speak of.

But two divisions of this region deserve special notice. A great semicircular area of Silurian and Devonian formation extends along the west coast of Hudson Bay, ending very abruptly at the southeast corner. This forms a flat clay country with some poorly drained land between the rivers. Along the coast we find the enormous tidal flats, bordered by low shores and brackish meadows characteristic of the west and south shores of James Bay north to beyond Cape Churchill on Hudson Bay. This is a great summer feeding ground for millions of wading birds and a great many ducks, especially Pintails, Black Ducks, and Blue-winged Teal. In the autumn great



## BREEDING AREAS

armies of geese of several species collect along this coast. Thousands of Canada Geese come here as soon as their young can fly.

The other region is that of the Great Lakes, where, especially along Lakes Huron, Erie, and Ontario, are extensive bordering marshes. These are important places for nesting Black Ducks, with some Pintails, and a few Blue-winged and Green-winged Teal. It is about the eastern limit of the breeding range of Pintail and Teal. The Wood Duck, of course, is common in the southern lake region, but does not penetrate north into the rough Laurentian forested regions. The St. Clair flats in southern Ontario are well known and most important. Several species that are rare breeders in other parts of the East are found nesting here.

### *Northeast Coastal:*

From our standpoint again this is another unimportant division supplying only Black Ducks, Goldeneyes, and Mergansers (three species). In a few spots here and there, such as the Magdalens, a few Teal breed, and some of the New York and Lake Champlain marshes supply a few Pintail and an occasional Mallard or Teal. The Black Duck is the only species of great importance among 'game wild-fowl.'

This was, of course, an important breeding ground for Wood Ducks, and the tendency is for this duck to increase in recent years, since given Federal protection. We do not consider this as a game species at the present time.

The southern part of this northeast coastal division has been greatly modified by the advance of industrial civilization. Parts of Maine, New Brunswick, and

## AMERICAN WATERFOWL

Nova Scotia have, however, remained fairly unchanged for fifty years. Large reservoirs for the supply of pulp mills and the regulation of river flow have tended to increase the water area in the State of Maine. The breeding grounds of our Black Ducks have not been seriously impaired, taking the region as a whole. The species is for the most part a scattered, evenly distributed breeder, for the reason that there are not many marshes or lakes supplying rich food for a real concentration. Black Ducks resort to the coasts as soon as their families are well on the wing and thus remain fairly independent of inland food supply. In Maryland and Virginia marshes natives are still said to practice 'egging' for ducks, rails, and gulls, but nobody can say just how destructive this is to the Black Duck.

An impression exists among many people, even some ornithologists, that this northeast region was once far more important as a breeding area for wild-fowl than it is now. There is little reason to believe any such thing. Wood Ducks have become scarcer through constant summer shooting, and other hole-nesting species have suffered through scarcity of nesting sites (Hooded Merganser, American Merganser, and Golden-eye), but there is no reason to believe that there has been any marked change in the breeding distribution of the more important game ducks. These have always clung to the Central West as the most favorable wild-fowl breeding-region in North America.

### *Keewatin Area:*

This great sub-Arctic region extends from the Albany River on the south to the Arctic Circle on the

## BREEDING AREAS

north, and takes in all the flats along the west shore of Hudson Bay. The western edge has a natural and very important geological boundary. This is formed by the line which sharply separates the gneiss and plutonic rocks (Laurentian) from the great level marine deposits of the Upper Cretaceous which floors our prairies. This is the most clearly marked of any boundary which we shall have to notice in our account of the breeding grounds.

On the south, this Keewatin region merges with the Western Laurentian in the great wet, wooded, belt which extends north to the limit of trees. Its northern third contains the center of the true Barren Lands, about the most inhospitable region in all Canada, sweltering hot and mosquito-ridden in summer and colder in winter than the Polar Sea. None of this has much importance for us at the moment, and a few words will give a rough idea of the game species which inhabit it. Much of it, of course, is still poorly mapped, especially back from the principal water routes.

There are thus really three parts of this Keewatin region, the southern woodland, the great flat coastal strip along the west coast of the Bay which appears to be due to a different geological formation (Silurian or Devonian), and the above-mentioned true Arctic barrens.

In the southern wooded parts there are a few Black Ducks, but how many really breed west of James Bay we do not know. The ubiquitous Mallard is also scattered through it with some Pintails and a few Canada Geese, Scaups, Golden-eyes, and Mergansers. The great coastal strip of the Bay forms a summer gathering-place for many water-fowl and innumerable wading

## AMERICAN WATERFOWL

birds, but we have no means of estimating its extent as a nesting area. It is backed in-shore by a flat, clay country with undrained land between the mouths of the large rivers. These tidal flats bordered by meadows and fresh-water pools extend north to and beyond Cape Eskimo in lat. 62°. Even the water of the Bay itself is far from salt, owing to the great volume of fresh water from the discharging rivers. This is one of the greatest concentration areas for various kinds of geese to be found anywhere in North America, and from here they work down into a sort of funnel to the marshes at the south end of James Bay, where many are shot by Indians belonging to the Hudson Bay posts.

The Barren Lands are poor in wild-fowl. Here and there a few pairs of the true Western game ducks may nest and some Hutchins Geese find their southern breeding limit here. And aside from this meager list there are a few non-game species such as Old Squaws, Surf Scoters, and Mergansers. The breeding ground of the Surf Scoter still remains to be worked out in detail, but we know it nests in the Rocky Lakes at the east of Athabaska Lake and north through the Barren Grounds.

This Keewatin region is not one that has suffered any great change in recent years. The kill of geese, particularly Lesser Snow, Blue, and Hutchins, has always been large on the fall passage, with a lesser number in the spring. The ducks are not hunted so consistently, although shot when the opportunity presents. If the 'Bay' is ever opened up and developed as a sporting resort, there is no doubt that the wild-fowl of this great region might be seriously affected.



*Blue Goose*

*Young*

*Adult*

*Snow Goose*

*Young*

*Adult*

*White-fronted Goose*

*Adult*

*Young*

*Eastern Brant*









## BREEDING AREAS

The great breeding area of wading birds begins in the Barren Lands and along the Hudson Bay coastal strip and extends north far into the great Arctic islands.

### *The Central Prairie Division:*

We now come to by far the most important region in all North America and one about which a whole chapter should be written. Roughly, it contains all the level prairie included in the great sedimentary deposits of the Upper Cretaceous, with, along its eastern edge, a narrow strip of the level Devonian and Silurian formations. Next to it on the east we come to the rugged Laurentian formation already discussed, from which it is separated on the map by a slightly wavy line from Great Bear Lake south across the middle of Slave Lake to the west end of Athabaska. Thence it runs southeast to the eastern shore of Lake Winnipeg.

The western edge of the Prairie Division is a natural contour line along the eastern foothills of the Rockies, extending westward in places up the broader valleys wherever prairie lakes exist. Southward we include parts of eastern Montana, some of Wyoming, a little of Colorado and Kansas, and all of Nebraska. Notice now that this great region is to-day the agricultural gold mine of the continent; the wheat and corn belt. This means that much alteration has come about through the hand of man.

The area looks large on the map, but for practical purposes it is really much smaller. We have sketched it as representing the potential or original natural area of greatest 'game wild-fowl' concentration in summer.

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Naturally the western edge, in Alberta, Montana, and eastern Wyoming, falls within the very dry belt and includes some nearly desert regions. Some of this waterless region has been greatly affected by reclamation projects which have impounded water for cereal and alfalfa growing. The southeastern block of this Prairie Division, including much of Minnesota, Iowa, and some of the Dakotas, has suffered greatly from intensive drainage (see Chapter I, Part II). The whole southern end of our division is now, of course, under intensive cultivation with corn and much of its value as a breeding ground has been lost. We know from old records that half of Minnesota and most of Iowa formed originally one of the finest breeding grounds for cranes, geese, ducks, and rails in all the continent. This has gone, never to return.

In the Dakotas the water is also reduced both by drainage and shrinkage of prairie sloughs, due to the cultivation of the land. Drought periods greatly reduce the area of water surface and marsh and then breeding ducks almost vanish for a time.

As we go north we find the open prairie, nowadays, of course, artificially planted with trees for wind-breaks and firewood, giving way to scattered natural groves of poplar, willow, alder, and spruce in Saskatchewan and Alberta. The true open prairie extends only about to Great Slave Lake. At last, two hundred miles beyond Edmonton, we reach the limit, or what now appears to be the limit, of agricultural venture. About half this Prairie Division of ours is now farm land and settlers are still crowding into central Alberta and Saskatchewan.

We have gone into this detail to impress on the

## BREEDING AREAS

reader the fact that the region of greatest importance, supplying at least two thirds of the game ducks of the continent, has been exploited and changed to a far more serious degree than any other region except California. Also to notice that its northern part is not nearly so wide or favorable as its central or southern extension.

We may ask what becomes of wild-fowl when displaced by a destructive invasion of their homes? This is a question difficult to answer. If a breeding ground is destroyed, it almost surely results in a reduction of the stock. Wild-fowl, or any other family of birds for that matter, can stand only a certain degree of concentration. Beyond this point disease, increased gathering of natural enemies, or an exhaustion of food will result. The presence of immense numbers of shallow prairie lakes, lakes of several different types, is responsible for the numbers of wild-fowl in the country we are considering. Many of these lakes are now shrinking, due to the more rapid run-off of rainfall from cultivated or overgrazed land. This process has been going on since settlers entered the country, relieved by occasional cycles of wet years. Many lakes become very strongly impregnated with alkali salts as they shrink, since they are no longer subject to a cleansing process during natural overflow. So that not only have many lakes become smaller, but they have become less suitable to plant growth and so less attractive to ducks. Beyond a certain degree of impregnation of water by salts, plants cease to prosper.

The marginal growth of tules and sedges may be affected by water shrinkage so that the nesting re-

## AMERICAN WATERFOWL

treats of diving ducks like Redheads, Canvas-backs, and Ruddies are greatly reduced. Fires, especially in recently settled land, such as one finds in central Alberta, have taken their toll of breeding ducks, and where tules are destroyed, there is no natural cover for the game diving ducks to nest in.

In settled country we may have fewer natural enemies, such as coyotes, bob-cats, raccoons, and mink, but as an offset we have stray dogs and cats, which are probably worse. We also have the mowing machine and the feet of domestic animals to destroy cover along pond and river margins.

Although Canada Geese no longer breed commonly in the southern part of the prairie region, we find that all species of game ducks, with the exception of the Black Duck, make this their principal home. This means at least fifteen species of 'sporting' ducks, with a number of other species, like the Golden-eye and Buffle-head, that are on the border-line between game and non-game ducks. Then add to this list two species of Scoters, the White-winged and the Surf, as well as three species of Mergansers, or fish ducks, and the importance of the region must be realized.

It is outside our present task, but we must not forget that a vast army of other water-birds nest in the prairie lakes, Rails of three species, American Coot, some of the larger shore birds, several species of grebes; loons, gulls, terns, and the heron family.

Speaking very generally the southern end of the prairies are populated mostly by Pintails, Blue-winged Teal, and Shoveler ducks, the middle section by vast numbers of Mallards, Widgeons, Gadwalls, and the



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more valuable game diving ducks, while the northern region has fewer species and is far less favorable to the bulk of our wild-fowl, exclusive of geese.

There is no great favorable area in the far North for most of the ducks which are pushed out of North Dakota, Saskatchewan, and southern and central Alberta. This point should be clearly emphasized because many people believe that the Arctic regions are more valuable as breeding grounds than they actually are.

We have mentioned a desert strip of country along the western edge of the Prairie Division, most marked in parts of Alberta, central Montana, eastern Wyoming, eastern Colorado, and western Nebraska. Our chapter on reclamation gives some idea of the changes that have been brought about here through the presence of storage basins, irrigation, and seepage areas from these great basins.

South of the Prairie Division (not, however, represented on our map) are here and there lakes lying at elevations where northern ducks can find congenial summer climates. Such a place is Lake Burford in northwestern New Mexico, which is 7000 feet above sea level. Here Dr. Wetmore found a good many Mallards, Gadwalls, Cinnamon Teal, Shovelers, Redheads, Lesser Scaups, and Ruddies, with a sprinkling of several other species, ten or eleven kinds in all. There are other places of a similar nature in Arizona and southern Utah. We mention them to show that latitude alone has little to do with the distribution of the game ducks.



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### *The Gulf Coastal Division:*

This is really not an important area and perhaps ought not to be mentioned at all in this hasty survey. Its usefulness as a wintering ground is well known. But we do have among these marshes a fairly important game duck, the Florida Dusky Duck or Mottled Duck, both sexes of which look a good deal like female Mallards. This species breeds in southern Florida and all along the Gulf Coast, at least to the mouth of the Rio Grande. They occupy all sorts of places, shallow ponds in the 'piney woods' of Florida, and tops of dykes and natural elevations, such as one sees in the vast marshes of Louisiana. Drainage in Florida has probably reduced the breeding grounds of these ducks. There is, however, no immediate danger to the species. They grow very wild when much hunted. A fair number of Blue-winged Teal also breed on or near the Gulf Coast. Two species of the curious long-legged, goose-like Tree Ducks, the Fulvous and the Black-bellied species, occasionally breed in the western parts of the Gulf District.

Aside from these there are probably no game species except very rarely a pair or two of Shovelers and perhaps an occasional pair of Mallards.

The great blank on our breeding map between the Gulf Coast and the Great Lakes is just what it appears, a near-desert for breeding ducks. True, the Wood Duck breeds all over it, with the exception of the high Appalachian Mountains, although now, of course, in greatly reduced numbers. The Hooded Merganser — not, however, a game duck — breeds in favorable places all over the United States. But these two members of the tribe have it very much to themselves.

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### *Western Mountain Area:*

The great chain of the Rocky Mountain and Sierra Nevada from the Alaskan border may be considered in one section of our account.

Like all elevated regions, it is poor in nesting areas, yet it harbors many low-lying valleys where slow-moving waters have been dammed up by natural barriers or by beavers, and formed lakes. We need only mention some of the great central lakes of southern British Columbia, like Okanagan Lake, the Flat Head Valley in northwestern Montana, and many inter-mountain regions in Idaho, Wyoming, and Colorado. These contain some nesting grounds for all the common game ducks. But in the mountains themselves are two very interesting species, the Barrow's Golden-eye, which closely resembles our common Golden-eye or Whistler, and the gaudy little Harlequin Duck. The former nests in cavities of dead stubs or other hollows, even once in an old barn, and the latter beside rocky streams in the wildest mountain retreats.

This region has not changed greatly except along the lower valleys where farming is profitable. In these places the same sort of dangers surround ducks that have been mentioned under our Prairie Division. Many of the drier valleys in Idaho, Montana, Wyoming, and Colorado are now under intensive irrigation.

### *The Southwestern Area:*

As we have traced it on the map this division includes the famous Bear River marshes in Utah and the whole of central California. There are now other areas in Utah formed by irrigation projects which may be of some importance. A few ducks also breed in the White

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and Mogollon Mountains of Arizona and in New Mexico.

As a whole this Southwestern Division is mostly elevated and very dry. Besides the Great Bear River marshes there were three other regions of major importance, the Lake region of southern Oregon and northeastern California typified by Lower Klamath Lake, Tule Lake, and Malheur Lake. The Sacramento Valley of central California and the San Joaquin Valley of central and southern California were also breeding grounds. This whole region, in spite of its southern latitude, once bred unbelievable numbers of ducks, and parts of it still do. But in the last forty years, due to drainage and overshooting, it has become of less and less value.

Dr. Wetmore's studies of the Bear River marshes in Utah show very well the numbers of breeding ducks and other water-birds that congregate there. In order of abundance they are Redhead, Cinnamon Teal, Mallard, Shoveler, Gadwall, Ruddy Duck, Pintail, and Green-winged Teal, with a very few Widgeon and Blue-winged Teal. This area includes the delta of the Bear River, where it empties into the northern end of Great Salt Lake, a region of vast marshes of sedge, tule, and cane, with huge overflowed flats where the water is only a few inches deep. At least 3650 pairs of ducks nest here, and many others begin to congregate early in the season from smaller breeding grounds in elevated regions near by. Besides the ducks, at least one hundred pairs of Canada Geese nest here. There are great varieties of water-plants of the finest kinds, but no wild celery.

In 1921, and to a less extent in other years, the duck



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sickness took frightful toll from this region, several million birds perishing in a few years (see chapter on 'Poisons, Diseases, and Parasites'). The dykes which are being built through Congressional appropriation, cutting off the saline waters of Bear River Bay, will, it is hoped, prevent further losses of this kind.

The southern Oregon and northern California lakes, which are shallow enough to be good duck lakes, have mostly been drained (Lower Klamath Lake, Tule Lake, etc.), so that here again a great territory is permanently out of our reckoning.

The great length of the Sacramento Valley was originally about all marshy. There followed a period when rice was grown over thousands of acres, mostly around Stockton. Now it seems that rice may give way to dry land crops. Indeed, the interior valleys of California are rapidly being converted into small farms and orchards. The great ranches and grain farms are cut up, drained, and converted into vineyards, while at the same time the population increases enormously. Tulare Lake vanished many years ago, and so the story goes. As a breeding ground California will remain unimportant. Scarcely any marshes are left except those preserved by duck clubs.

The characteristic breeding ducks of the interior of California were Mallards, Gadwalls, Green-winged Teal, many Cinnamon Teal, a few Shovelers and Pintails, a few Wood Ducks, and many Redheads and Ruddies. The Fulvous Tree Duck nests in the southern part of California only.

It looks very much as though we had better forget entirely all of the interior valley lands of California so far as breeding areas are concerned. The land itself has



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become valuable, and in places even rich duck clubs must sooner or later give up their holdings. Water also is scarce in the southwest coast districts and its use for purposes of sport alone will not be justified indefinitely.

### *Alaskan Region:*

This region appears on our map as the Yukon Valley and Arctic Circle on the north and all the region south of it within Alaskan territory. It is of great value, but it does not contain anything like the variety of game ducks that are bred in the Prairie Division. The most desirable of the diving ducks, Canvas-backs, Redheads, Ring-necks, and Ruddies, do not breed here at all. There are some Green-winged Teal, it is true, a few European Teal on the west end of the Alaskan Peninsula, and a good many Mallards and Pintails, especially the latter. The Widgeon also is common. The Canvas-back has been found breeding on the Yukon, but it must be at best a very rare duck in Alaska. The Greater Scaup is a common duck in western Alaska. The Lesser Scaup probably does not breed there at all.

Of the non-game species we have the Harlequin, Barrow's Golden-eye, Steller's Eider, the rare Spectacled Eider, the common Pacific Eider, and the King Eider, but those are all unfamiliar names to the ears of most sportsmen. There are some scoters breeding in western Alaska also. The region is rich in geese. There are some Canada Honkers throughout the wooded belt, Hutchins Geese farther north, the White-fronted Goose, the White-cheeked Goose (a local race of Canada Goose resident on the southern coast of Alaska), and the miniature Cackling Goose, smallest of the

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Canada Goose family, scarcely heavier than a large duck. This Cackling Goose seems to be the only goose that breeds far west on the Peninsula and the western islands. We must not forget the very interesting Emperor Goose, which is almost unknown to sportsmen because it does not, except in rare cases, leave Alaska. It is a hardy winter bird of the far North, marine in its habits.

The main Alaskan breeding grounds are north of the Alaskan Peninsula, for generally speaking the north shores of the Peninsula are more sloping and less rugged than the southern coast. North from here we have one of the finest breeding grounds in North America, the great marshy flats at the head of Bristol Bay, the delta of the Kuskokwim and the huge delta of the Yukon up to Norton Sound; level country of woods, beaver ponds, marshes, and endless wandering watery channels extending far inland all along this western coast. Much of it is still unexplored and remains exactly as it always was. There is not much true tundra country in this Alaskan Division except on the Seward Peninsula. The true barrens are mostly north of the Arctic Circle. There are certain sections where geese of several species are killed in small numbers by natives before they are able to fly, or when moulting, as at Hooper Bay, where the Eskimos drive Cackling Geese and Emperor Geese into nets, but this is not a serious destructive factor. Such practices are successful only in certain favorable spots.

There is not any great breeding ground on the Alaskan Peninsula itself nor on the Aleutian Islands. Mostly this is too mountainous. South of the Peninsula there are flats about the mouth of Cook's Inlet, a

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narrow coastal-plain strip from Dry Bay to Prince William Sound, including the Copper and Bering River flats (a rather large area).

Most of the coast of southern Alaska is of course precipitous with coastal mountains very near the shore, glaciers discharging into the sea, and deep water generally. There are, nevertheless, some smallish breeding grounds at the mouth of the Taku and Stikine Rivers and probably in other valleys.

### *The Western Arctic:*

We know rather more about the birds of this division than we do about those of the Eastern Arctic, thanks to many expeditions working in the vicinity of Point Barrow, the Seward Peninsula, and around the mouth of the Mackenzie River.

We have included here all of Alaska north of the Arctic Circle and all of Arctic Canada east to the one hundredth meridian. This division also includes some of the largest of the Arctic islands, Bank's Land, Prince Albert Land (Victoria Island), etc. It is a true barren-ground region of open tundra, with, in Alaska, the Endicott range of mountains some distance back from the Arctic Coast. Around the delta of the Mackenzie and eastward is a huge level area of Upper Cretaceous formation, while on some of the great islands, Victoria Island and Prince Albert Land, are less rugged areas of Silurian rocks.

First as to breeding swans and geese. The West Arctic Coast and islands are the home of the Whistling Swan. From this far region many of them make their great overland journey to the coast of Virginia and North Carolina, possibly without a break. They are

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persecuted by natives wherever found, but fortunately they have a very wide range and are nowhere concentrated. They deserve some degree of protection on their wintering grounds. We have, too, several species of geese, Hutchins and White-fronted, scattered through the interior. A few Cackling Geese on the Seward Peninsula, but mostly south of the Arctic Circle, while Lesser Snow Geese in great numbers breed all along the Arctic Coast, eastward from Point Barrow. The Black, or Pacific Brant is a very far-Northern breeder on the West Arctic islands and Arctic coast of the mainland, westward along the Siberian coast. There must be a very fair number of these Brant shot by natives, judging from A. M. Bailey's account of the 'Birds of North-Western Alaska.'

We must include (by a process of elimination) the little Ross Snow Goose as breeding in this West Arctic. We know nothing of its summer range, but we may guess that it is somewhere in the far North among the western Arctic islands. This beautiful bird winters mostly in the interior of California. Its summering ground remains almost the last of the wild-fowl mysteries yet to be solved.

The Hutchins Goose, as we have mentioned before, seems to be scattered throughout the interior, probably nowhere in any great concentration. O. J. Murie found it breeding about the Old Crow River, north of the Porcupine River, in Alaska. It no doubt intergrades with the little Cackling Goose in parts of western and northern Alaska, for specimens are taken which are very difficult to classify. In the south, it may intergrade also with the White-cheeked Goose of the southern Alaskan coast.



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Now then for the ducks of the West Arctic. Leaving out of account the four species of Eiders, the great assemblage of Old Squaws, Barrow's Golden-eyes, and some Scoters, we find 'sporting' ducks very much in the minority. The Mallard is not common so far north, although a few are scattered here and there. The same may be said of the Green-winged Teal. The Pintail is, of course, the typical shoal-water duck of the region and is numerous everywhere. We should call attention again to the enormous area of the breeding range of this duck, from Bering Straits on the north-west to Lake Erie on the east, and from Point Barrow on the north to southern California on the south. The Baldpate shares this West Alaska area with the Pintail as about next in order of abundance of the shoal-water ducks.

The only 'sporting' diving duck to be found is the Greater Scaup, which ranges more or less all over Alaska, but perhaps mostly south of the Arctic Circle.

The most favorable breeding grounds for the game ducks appear to be the Kotzebue Sound region just on the Arctic Circle, the Delta of the Mackenzie and the region east of it, including the valley of the Anderson River and other small Arctic rivers in this neighborhood. The great waste of extreme northern Alaska inland from Point Barrow is mostly mountainous and probably contains very little favorable swamp and tundra.



## CHAPTER II

### THE NORTH AMERICAN WINTERING GROUNDS

BEFORE we consider the winter areas, let us glance at a map and consider how wild-fowl arrive at their winter quarters. We have been taught to believe that our ducks and geese, stimulated by frost or ice, leave their nesting grounds on a certain day and travel more or less due south at various speeds to their winter quarters. Nothing could really be farther from the picture as we begin to see it to-day. We have in reality an almost constant series of movements beginning in some species as soon as the clutch of eggs is laid.

Many males leave the females at this time and seek broader waters or more abundant food while they cast their quills and moult. So begins a complex series of local migrations, some, as in the case of the Pacific Eider, a marked early July migration west along the coast of Alaska.

When the young can fly, there begin local flights to areas of summer concentration. Possibly many of

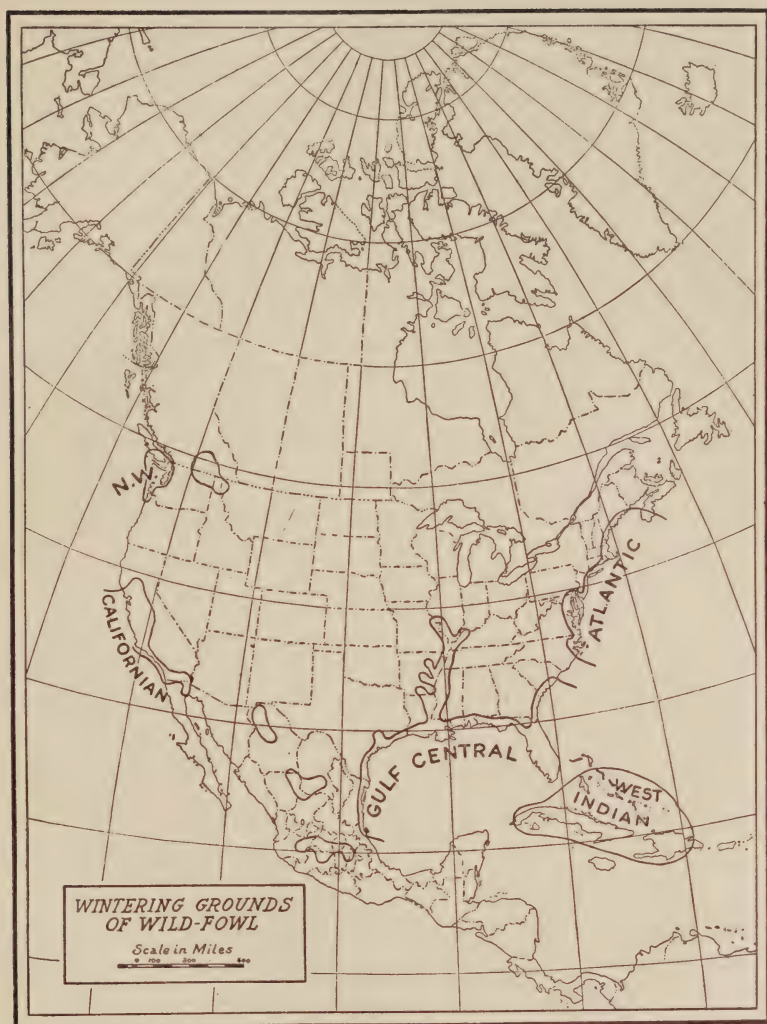
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these are north, not south, but they may be in any direction or for any distance. The Black Duck begins to concentrate near the coast in July and early August.

The young of many ducks often separate from the female, leaving her to complete her moult. They may begin their true Southern migration long before the parent or parents start on theirs. We must conceive, therefore, of great streams or groups of wild-fowl, converging at certain points, separating at others, crossing each other and fanning out so as to trace a maze of lines which on the map would appear an absolute network. Some groups of Mallards, for example, keep to a well-established flight route, but every year a few of them, say five per cent, wander outside the established migration range of their fellows. In England, where Mallards are nearly sedentary, banding work has shown that a certain few, without rhyme or reason, dash off to far-away breeding grounds like Finland or Scandinavia.

Wild-fowl migrate in almost every direction. From the same general region members of the same species may travel southeast to the Atlantic Coast or southwest across the Rocky Mountains. Some come south over an easterly route and probably return by a more westerly one. Mallards, which strike the middle Atlantic Coast in October and November, drift slowly south and are seen no more after late December or early January. They do not appear on the Atlantic Coast in spring in any considerable numbers. Other species show similar tendencies, but we have much to learn on this point. Other groups of birds, such as the shore birds, carry out similar elliptical winter flights.

It is important also to remember that many species







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(Blue-winged Teal, Shovelers, and Wood Ducks, especially) commence southward journeys long before cold weather or lack of food could possibly affect them. By late August bands of these ducks are set in motion, even in temperate latitudes, while in the far North at the same time freezing weather may move Pintails, Widgeons, and many of the sea ducks. The reasons back of migration, therefore, vary very much with different species and with different groups of individuals within the same species, and at best are little understood.

But however the various species arrive on their wintering grounds, we can easily see that the act of migration, due to whatever cause, does bring about a very definite concentration of nearly all the game ducks. The great interior of the continent is largely deserted, while regions on or near the coast, mostly empty of game ducks during the summer, become once more populated with millions of wild-fowl. A few stream on past Florida to the West Indies and even to Central America and the north coast of South America. Some few pass into Mexico and roughly as far as the Isthmus of Tehuantepec, while scattering and perhaps partly 'lost' ducks reach the Hawaiian Islands and other Pacific insular groups.

There is, of course, no moment of the winter season when all movement stops. Canada Geese are regularly seen in southward flight over Massachusetts up until January 10th nearly every year. Mallards and other hardy species may remain far into the winter in the interior of the upper Mississippi Valley, wherever they have some open water and near-by grain fields to feed in. Flocks of these ducks spend the winter in warm

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pockets as far north as Alaska and in spring holes scattered throughout the northern Rockies.

Wintering grounds may be deserted by the end of December as is often the case in the Back Bay of Virginia. It is difficult to account for these sudden mid-winter movements. In many cases, the supply of food becomes exhausted and overshooting or over-disturbance likewise must be reckoned with. But whatever wintering region we take a cross-section of, its wild-fowl population will change in all sorts of ways from week to week, all through the season from September to April or May.

Bearing in mind all these possibilities and realizing that there is in no known wintering ground any period of absolute stability of wild-fowl population, we may set the first week of January as the best time for a general winter census.

We have drawn some arbitrary areas on the map of North America in order to make it easier to consider in a broad way the wintering grounds of wild-fowl. The first of these is the North Atlantic Coast region.

### *The North Atlantic Area:*

This is probably the best-known wintering ground of all, extending from the southern tip of Nova Scotia along the coast of New England, south to the middle of the coast of North Carolina, at New River, Onslow County. So wide are some of the sounds and so deeply do bays like the Chesapeake cut into the heart of Maryland, Virginia, and North Carolina, that this flat coastal plain, with its sluggish rivers, has made possible combinations of fresh, brackish, and salty waters which form a region of immense variety for

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about every species of duck. This region is so familiar to thousands of Eastern sportsmen that perhaps no great amount of space should be wasted in describing it. Yet even in territory so well known as this we find surprising ignorance among duck-shooters about the winter distribution of their favorite game. Even among those best informed there are gaps in our knowledge concerning winter movements of ducks.

Starting at the north, many will be surprised to hear that in a few bays in southern Nova Scotia (Barrington Bay, mouth of Sable River, Port Le Herbert, and Port Joli Harbors, etc.) we find conditions open enough to make this a regular winter feeding ground for twenty to twenty-five thousand Canada Geese and many thousand Black Ducks. Some geese remain north until early January, and we do not know for certain where our January flights of geese come from when they strike the vicinity of Cape Cod in Massachusetts. Save for sea ducks of several species, including many Eiders, Scoters, Old Squaws, Golden-eyes, a few Buffleheads, and a rare Harlequin or two, there are not many game ducks in eastern Maine. Black ducks increase as we go southwestward toward less rocky shore lines, reaching considerable numbers in southern New Hampshire and near Boston.

The whole area of Cape Cod and the Rhode Island shore winters in most of the harbors a large body of Black Ducks, Golden-eyes, Greater Scaups, and many sea ducks of less interest to sportsmen. A very few of the more desirable ducks, such as Widgeons and Redheads, sometimes winter on Martha's Vineyard Island in Massachusetts. An increasing body of Canada Geese winter on Cape Cod and many more Brant



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are now found on 'the Cape' and the Massachusetts islands than used to winter with us before spring shooting was stopped.

The bays along the Rhode Island and Connecticut shore support no game ducks except Black Ducks, Greater Scaups, and Golden-eyes. The Eiders, except a few King Eiders, do not much more than get around Cape Cod.

Along the shores of Long Island Sound we have a highly industrialized coastline, very thickly settled and of small value for holding any but the 'common' ducks, although here and there the rivers contain marshes, frozen, of course, by January. When we come to Long Island itself (southern New York), we find sounds (Great South Bay and Peconic Bay) running nearly the whole length of it. Here, and along the great length of the coast of New Jersey, immense quantities of Greater Scaups, some Lesser Scaups, some Redheads, and large numbers of Black Ducks winter, with a good showing of Brant and Canada Geese. Much ditching for mosquito control, some filling, and a great deal of house-building is making the New Jersey coast less attractive to wild-fowl and shore birds. Pollution from mineral oils is becoming more serious every year.

All these sounds are salt or near salt, with such coarse foods as eel-grass, great quantities of minute shellfish, and more desirable foods in less volume. Hence the wild-fowl are not to be compared in table value to the fowl of the Chesapeake, farther south. Ice, of course, often closes a great deal of water in all this region and fowl drift to other regions for a time.

The more interesting resorts for 'sporting' wild-fowl

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begin in Maryland and Virginia, where the great bays with their sluggish tributary rivers have formed the vast flats suitable for many valuable foods, such as wild celery, sago pond weed, and widgeon grass. Here are the famous river bays between Baltimore and Havre de Grace, with many places of lesser note south to the Patuxent, Potomac, Rappahannock, and James Rivers. Then there are the vast marshy islands, tidal bays, and brackish rivers of the east shore. These flats attract enormous flocks of Redheads, Canvas-backs, Lesser Scaups, Pintails, Mallards, and Widgeons, species that scarcely touch the coast-line east of Delaware Bay. Add to this the coastwise flight of Canada Geese, Brant, Black Ducks, and common salt-water ducks. Gadwalls now appear in numbers, varying greatly from year to year. The season 1928-29 was one of great abundance for this duck in the East and also in the lower Mississippi Valley. Here all ducks contend with the greatest concentration of shooters anywhere in the United States, for many of the most famous bays are only an hour or two from large cities and are to-day reached by perfect motor roads. Other places on the 'east shore' still have to be reached by boat, and the roads are rather poor, but all this is changing fast.

The adverse factors affecting wild-fowl in the Chesapeake Bay are fortunately few. Drainage has made almost no progress. Floods have at times been disastrous in washing out plant food in areas like the Susquehanna flats; ice also is damaging to aquatic plants. Dams on the Susquehanna River have apparently controlled the worst of these floods.

Pollution is not as yet serious. The sewage of Baltimore is now disposed of by some system which

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prevents the dumping of surface oil and garage waste into the waters of the bay. The amount of waste oil which is now washed into street gutters and so into some of our harbors is becoming a very serious factor in many places, and will have to be taken care of by special provision. It destroys aquatic plant food as well as fish, and in our harbors becomes a fire menace. Wild-fowl are not the only sufferers.

Some day, probably, the development of the shores of Chesapeake Bay for summer colonies may become a serious adverse factor.

Battery shooting is allowed by Federal regulation on certain coastal waters and sounds, but not on tributary waters. In an area like Chesapeake Bay such regulations involve a certain number of very necessary but rather arbitrary rulings, and some dissatisfaction, of course, results. Even a Philadelphia lawyer would be hard put to it to decide where a bay ends and a river begins, especially in this particular part of the world.

Batteries are also more or less controlled by State and County law. In some places like Back Bay in Virginia they are arbitrarily limited to a certain number by the State. It is difficult to see how such ruling can remain permanent, as it is distinctly class legislation and subject to inevitable abuse.

Overshooting by batteries tends to defeat its own object because ducks are either driven off their feeding grounds or made so shy that they become 'battery-wise.' Various self-made regulations by clubs have limited the number of days of shooting per week or the number of hours per day, all over the Chesapeake region. This is a frank attempt to hold ducks on the shooting grounds. The leisurely life at the old-

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fashioned duck club, where one stayed for several weeks, is now entirely changed and the shooting is carefully regulated.

There are still some lawless elements operating in many parts of Maryland and Virginia; especially on the so-called East Shore Peninsula. Night shooting, the use of big guns, wholesale marketing of ducks, and the taking of the eggs of Black Ducks from the nests in the spring, still go on. To offset this, the muskrat fur industry has assumed increased importance, and this may help to preserve marsh areas and reduce indiscriminate hunting.

Gradually, as clubs and sportsmen become more interested in game protection and the generation of old, hardened offenders passes gradually to the happy hunting grounds, conditions will, we hope, improve. Universal recognition of game as a recreational, rather than a strictly economic asset, will do much to clear the air.

We know very little, indeed, about the winter movements of ducks in the lower Chesapeake and in Currituck. What becomes of the ducks that are frozen out of the Havre de Grace flats and other shallow bays? Is there an interchange of Canvas-backs, Redheads, and Scaups between the Chesapeake and Currituck regions? Where do the Currituck and Back Bay (Virginia) ducks go when they are frozen out or driven out by various causes? Only extensive banding of diving ducks can throw any light on these points and also give us an idea of the relative numbers of these ducks which fall to the gun each year. We have a great deal better knowledge of the surface-feeding ducks, through banding, than we have of the diving ducks.



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How many wild-fowl are killed in the Chesapeake Bay? Probably at least one third of a million, perhaps more. The Maryland State Conservation Department estimates one half million. Estimates have also been made for Virginia (about 74,000), but these do not include the 'East Shore,' which is an important region. That portion comes under the jurisdiction of a Fish and Game Association covering two counties in Virginia.

We must barely mention the scarcely less famous regions in southeast Virginia and North Carolina. The Back Bay, one of the greatest regions for swans, geese, and almost every species of the best game ducks; Currituck Sound, lined with dozens of clubs; parts of Albemarle Sound, the outer flats of Hatteras Beach along the east shore of Pamlico Sound, Mattamuskeet Lake, the Pamlico and Neuse Rivers, and Core and Bogue Sounds.

The great body of the more desirable ducks and most of the Swans do not stray far south of the lower end of Currituck, where the water begins to get salt. Brant reach their southern limit in the south end of Pamlico. Redheads sometimes go into the salt water of Pamlico in large numbers, but not much farther south. Canvas-backs scarcely go this far. Currituck Sound was salt, due to an opening through the beach previous to 1830. We must not forget that all these sounds and beaches are constantly changing. We may keep beaches built up by artificial means in order to keep out high tides. This has been done along many low stretches of Currituck and Hatteras beaches. But man has interfered, and by removal of the locks in the Chesapeake and Albemarle Canal, has allowed a flow

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of salt water to enter Currituck Sound, thus seriously affecting the plant foods. Other natural resources, like the black-bass fishery, have also been greatly injured. We have good reason to hope that the locks will be restored in the near future.

Generally speaking, Pamlico is the southern limit for the great mass of Atlantic Coast marine wild-fowl, and here millions of Scoters (three species), Golden-eyes, Buffle-heads, Greater Scaups, Mergansers, and Loons spend the winter in the greatest safety. In those huge sounds pollution is rare and overshooting almost impossible, for the fowl do not have to go to sea to escape bombardment. There is always room and to spare.

Pamlico is also changing in recent years. The New Inlet closed about 1920 and the water in the upper sound is now much fresher than it used to be. Shellfish have died out, as well as eel-grass. The Brant have been affected and ducks also. If Oregon Inlet closes, as it may some day, still greater changes will follow.

The New River, Onslow County, North Carolina, is about the southern limit of the Atlantic area. It is not very important except for Scaup.

All these Eastern sounds are influenced by a series of dry years. If the Carolina rivers fail, the salinity extends much farther up from the sea and plant foods are killed out temporarily. A 'sea tide' coming over the low beach may also change the saline content of the sound water for a time.

North Carolina shoots at least 60,000 to 75,000 wild-fowl, Virginia another 100,000 at the least. This with the kill estimated for Maryland gives some idea of the actual numbers of ducks and geese present;

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well up toward four or five million during an average winter season.

We can make a rough guess as to the numbers of game ducks and geese shot in this whole area in order to give an idea of its importance. Of course many of these fowl are shot on migration, not really while wintering. This number cannot be less than 700,000 and possibly even one million for the North Atlantic area as a whole. We believe this figure is very conservative.

### *The Gulf-Central Region:*

A gap, more or less well defined, separates the Atlantic area from the Gulf-Central. The coast of South Carolina and Georgia harbors a very different assemblage of game ducks from the Atlantic region; geese are almost entirely lacking. Formerly, before the sea-island rice culture decreased, regions like the lower Santee and other sluggish rivers were certainly better wintering grounds than they are to-day.

The old ditches and canals, levees and 'reserves' or reservoirs, are still in more or less repair and form good avenues of water travel on many valuable ducking properties.

This is a region for Mallards, Black Ducks, Pintails, and Teal. We have left behind most of the Greater Scaups, Canvas-backs, and Redheads, and all the Canada Geese and Brant. The Black-jack or Ring-necked Duck begins to appear and is very widely distributed in Florida inland waters. The Lesser Scaup is common and along the enclosed salt-water lagoons forms the principal game-duck supply. The Georgia coast is not really important, nor is part of the Florida

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coast except for a few species (mostly Lesser Scaup), which, by the way, are much reduced over former years. There are some large private holdings among the islands off Georgia which form a rather important sanctuary area.

The inland lakes of Florida support fair numbers of Mallards, Teal, Pintails, and Ring-necked Ducks, with of course a few Florida Ducks. The Gulf Coast of Alabama and Mississippi is not an important wintering area, but a little farther west we come to the famous Delta region of Louisiana. We must now glance at the Mississippi Valley, which is chiefly a migration area, although a considerable number of surface-feeding ducks also winter there.

The Mississippi River freezes as far down as St. Louis or Cairo in ordinary years; the Missouri within a short distance above St. Louis. The Ohio Valley is not a true duck region.

Neighboring sloughs, back channels, and flooded ground, of course, freeze before the larger rivers. As a rule there are no very large bodies of wild-fowl in the valley above St. Louis after the first of January, and these are mostly Mallards, Pintails, and Gadwalls. But many ducks come back by February and early March, so that the winter absence is often a very short period of only four or five weeks.

The Valley area has been greatly modified by levees, drainage, and in places by reservoirs to control the flow of water on small tributary streams. Reelfoot Lake in Tennessee, Big Lake in Arkansas, the deltas of the White and Arkansas Rivers, and the prairie (and rice) areas between them (Stuttgart neighborhood), besides many old river channels on the west side of the



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Valley above Memphis, form the best duck regions. Add to this the Red River section of northwestern Louisiana and parts of northwestern Mississippi. Many of the constantly changing islands in the main river have good feeding lakes upon them or shallows where there is some food. Geese are not nearly so plentiful on the river bars as they used to be, due probably to much persecution. Until the motor car brought good roads and the gas engine fast motor boats, a great deal of the Mississippi Valley was difficult to get at, but most of it is now available to the casual gunner. Some system of refuges seems to be indicated along the main river so that fowl may have rest areas.

In general the whole river valley below Memphis, or an area three hundred and fifty miles north and south and one hundred and fifty miles east and west (widest in Arkansas), may be considered the heart of this wintering region. Favorable conditions depend upon the height of the river and a kind of sympathetic height of inland waters. If the river is at the mark of eighteen feet at Memphis in January, ducks are concentrated in back waters. If over twenty feet, there is too much water for shooting purposes, as the ducks can spread out over a large area; conditions that are good for the ducks are bad for the sportsman.

From the Delta of the Mississippi westward along the whole coast of Louisiana and Texas and extending south along the coast of Mexico to beyond Tampico, we have probably the most important single region, if it can be so called, in all North America. The best-known marshes are those in Louisiana where some splendid refuges have been created. These are the Paul J. Rainey Refuge of the National Association of

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Audubon Societies, Marsh Island of the Russell Sage gift, the large Rockefeller Foundation tract, and the Louisiana State Game Refuge. The Orange Cameron Land Company owns great tracts in the southwest corner of the State, the Louisiana Furs, Inc., in Vermillion Parish, while in the Delta are the tracts held by the former Delta Duck Club and Mr. Joseph Leiter, besides the State public shooting ground.

The Blue Goose is confined almost entirely to the coast of Louisiana and eastern Texas, and as we go westward its place is taken by the Lesser Snow Goose. There are many White-fronted, Canada, and Hutchins Geese also. The whole coast westward from the Delta is a bird paradise. Twenty-seven clubs in Louisiana killed in the 1927-28 season 68,500 ducks and 1500 geese. These were largely Mallard, Pintail, Gadwall, Teal, and Blue Geese.

Nearly all the ducks find winter quarters here, but even so far south as this we find that the wild-fowl population is continually changing. Many Teal and Shovelers are absent during mid-winter and increase again in February and March.

Here also are many Ring-necked Ducks, Canvasbacks, Lesser Scaups, a few Redheads, and a sprinkling of northern Black Ducks and Florida Ducks among the vast numbers of Mallards and other common shoal-water species. All three species of Teal winter here.

The great value of the muskrat fur industry is a recent development which may indirectly benefit the wild-fowl, for it means that the marshes have acquired a new value.

The curse of oil has not yet done much damage, although there is an oil district in the southwestern

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corner of the State near Jennings, and others are now being prospected. We may extend this region along the whole dry coast of Texas, and the coast of Tamaulipas in Mexico, to the great Laguna de Tamiahua in Vera Cruz. We do not know much in detail about the southern end of this strip. The great Laguna mentioned above is brackish and mangrove-lined and holds Scaups and Redheads; what else we do not know in detail.

A word more about the Texas coast. It is, or was, a paradise, although the marshes are not so deep or extensive as in Louisiana. Parts of Galveston Bay are good, and also Lakes Surprise and Stevenson; also Matagorda Bay and the region near Rockport. The southwestern Texas coast was formerly a great shipping-point for Canvas-backs in the days of wholesale market hunting. It is perhaps more of a diving-duck region than a Mallard and Pintail resort.

But the curse of oil has hit the Texas coast, and to this must be added the sulphur fields. Most of the large oil industries are north of Galveston on the coast; Port Arthur, Beaumont, Goose Creek, Houston, and Orange are said to be the chief places. At Hoskens Mound and at Freeport, south of Galveston, there are sulphur works which discharge various chemicals and some oil into coastal waters. Another sulphur field at Gulf discharges into Matagorda Bay.

South of Gulf there is little pollution and the southern part of the coast is clean. Due to the powerful commercial interests at stake, the State of Texas has been unable to control the pollution of its coastal waters and the situation is somewhat discouraging.

A great deal of the coastal strip of Mexico consists of

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salt lagoons, some of them brackish, but there is very little fresh water, as it is a dry region. The lagoons are mostly narrow, and as a whole this cannot be nearly so important an area as eastern Texas and Louisiana.

### *Inland Mexico:*

There are three roughly separate areas in Mexico which should be mentioned. Taken all together they are important, but just how important we do not really know. No proper investigation has been made, although the United States Biological Survey has sent one expedition to report on the important lakes and marshes. Political troubles in Mexico have delayed other attempts to make a survey of wild-fowl conditions.

The northern of these three regions is in the tableland of Chihuahua, at an elevation of 4500 to 6000 feet. It is almost a desert, yet there are shallow lakes of some importance, such as Bostillos Lake and Lake Santa Maria, besides many smaller ones. Most of these dry out in a series of dry years. They are little disturbed and not affected by drainage, as this, except for a little irrigation, is a cattle country and sparsely settled.

Probably few diving ducks winter here, but many Mallards, Pintails, Teal of three species, and Snow Geese (Ross's Goose?). Probably there are other geese here, not yet reported, besides Sandhill Cranes and many shore birds.

The second Mexican area includes parts of the States of Durango and southern Coahuila. This is an irrigated cotton-growing section for the most part and rather favorable for ducks. Much of the land is flooded



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in the autumn and kept flooded for several months, and owing to a system of crop rotation with 'summer fallow,' great quantities of weeds grow up in the resting fields, producing good food crops for wild-fowl. The ducks are mostly surface-feeding species with a few Canvas-backs and Scaups. There are some geese, but what species predominate we do not know. The most important lake, Lake Meyran, has had its water supply cut off and is now largely drained.

Another area farther south may be called the southern tableland region, including the so-called Valley of Mexico which lies at 7400 feet above the sea. Farther west in Jalisco, Michoacan, and other States, the tableland is not so high, 4500 to 5000 feet. This area is not nearly so important as it was once, due to continuous drainage in the lake region near Mexico City. The water and marsh areas there are now greatly reduced. Systematic shooting by batteries of large guns called 'armadas' constitute the ordinary procedure here for supplying the markets of Mexico City.

The largest lake in the western part of the region is Chapala, which has been partly drained, and although much of the lake still remains, the marshy area at the east end has been ruined. Other lakes are Patzcuaro and Quitzeo in the State of Michoacan.

It appears that few geese get this far south, although Major E. A. Goldman was told that many used to go there. What has happened we do not know.

The chief game ducks here in relative order of abundance are Pintails, Blue-winged and Cinnamon Teal, with some Green-wings, Shovelers, Widgeons, and a few Canvas-backs. Mallards appear to be ab-

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sent or very scarce. A few of the rare Diaz Ducks, looking like female Mallards, are the local breeding ducks of the region.

Southwards there is no very important winter area, although some Blue-winged Teal and Pintails scatter down through Central America. There may be a few of our ducks in British Honduras, and a few go to Lake Nicaragua and as far as Panama. These far-southern records are chiefly of ornithological interest and they do not particularly concern the sportsman.

In this connection we might add that we know very little about some of the lagoon regions in Sonora and Sinaloa, which may hold many ducks. There is some irrigation in Sinaloa, which is said to be a paradise for water-birds of all sorts.

### *The Northwest Coast:*

A large area of some importance lies along the east and south shores of Vancouver Island and along the coast and interior of Washington, from Bellingham Bay south to Tacoma. This is mostly salt water bordered, in some places, by bold shores. It is, therefore, not of much importance as a winter feeding ground, except for the less desirable marine species and for the Pacific Brant. However, the territory is so large that in the aggregate a good many Pintails, Widgeons, Mallards, and geese use it. This region may be said to extend to the mouth of the Columbia River and to Vancouver Island.

### *California Region:*

We must think of this area as partly a breeding one (but not important), partly — and in great measure — migratory, and partly as a winter refuge.

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The whole California situation is tremendously complicated due to the great changes which drainage, reclamation and irrigation, settlement, increase of population, and rise in land values, have effected. It is, therefore, impossible to speak of California in anything like general terms. We have several hundred duck clubs, some of them the largest in the country both in area and membership. We have these clubs controlling natural areas like the Suisun marshes and artificially produced ducking grounds like those in Orange County near Los Angeles. We have almost all the clubs baiting on a scale never known before: baiting with damaged wheat, broken rice, and even waste from the sugar-beet mills.

With good roads almost everywhere in the low country and a very large class of persons able to enjoy some leisure, it is doubtful whether California would have many ducks were it not for the club system of shooting. Naturally enough there is some ill-feeling toward these clubs, more here than in other parts of the United States. The situation is just opposite to what it is on the Atlantic Coast strip, where most of the ducking grounds are actually on the coast and therefore largely open to the public.

The wintering area of California consists in the main of only a few salt-water bays like Bolinas, Bodega, and San Diego Bay, where a great many Black Brant used to winter. For the most part the coast is bold and uninviting and not to be compared with the Washington coast or the Atlantic region. Few game ducks use it except as a refuge.

Large flights of Pintail, and some Spoonbill reach inland California valleys very early in the season,

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even by late August. Most of these are later replaced by flights of Mallards and other ducks that come in when hard weather freezes the Oregon and Washington lakes and other inland waters. Where do all the California ducks come from? This question should be easily answered in the future through intensive banding. We suppose that the bulk of them come from Alaska, with an undetermined number from the Northern Prairie region; Canvas-backs and some Scaups certainly. The geese come chiefly from Alaska and some of these geese are found in winter nowhere except in California.

But a great many ducks must also come from northern Utah and near-by breeding grounds, for banding work has clearly shown the natural spread and interchange between the California and the interior ducks.

It has been said that a million ducks are taken in California in a good season, and even larger figures are mentioned, up to two or three million. The better clubs are very loath to give out information for fear of delivering themselves into the hands of the non-club elements, who naturally greatly outnumber them and are not sympathetic with the club system.

It seems as though the two hundred or more large California clubs must kill at least a quarter of a million birds, and the State bag must be, we think, over one half a million and very likely three quarters of a million.

Where do the California migratory ducks go in January and February? Evidently there is a drawing away from the interior of California after late November and December. Many birds are shot, of course, but many more retire to other regions. Do they tarry for



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a while in the Salton Sea-Imperial Valley territory of southwestern California, with some spilling over to the delta of the Colorado, northern Lower California, and possibly northern Mexico? Yet we know that there are few ducks in the Imperial Valley compared to twenty years ago. Do the bulk of them possibly return by very early spring migration *via* the desert valleys of Nevada and Utah without again occupying the interior of California? There may very likely be among Western ducks some elliptical migration routes such as we have indicated for the Eastern United States.

The principal areas of shooting concentration in California now are first, the middle Sacramento Valley around Marysville, and Buttes, where there is a good deal of rice. Then the natural Suisun marshes at the northern extremity of San Francisco Bay and the big tule area along the delta of the Sacramento and San Joaquin. Also the marshes at the southeast corner of the bay, where there are many small clubs without much ownership of land. Then the Los Banos region in the lower San Joaquin Valley, and the Firebaugh area well up the San Joaquin. There are marshes at the mouth of the Salinas River on the coast near Monterey, and a small area on the coast near Santa Barbara (mostly artificial); also the Orange County (Los Angeles) ducking region, which is largely artificial.

The upper San Joaquin is now mostly dried out and irrigation ditches on a large scale have greatly modified the whole valley.

Opinions differ as to the amount of wintering grounds left for the future in interior California. Heavy autumn rains doubtless increase the attractiveness for ducks, as does also the culture of rice and the

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culture of grain. As these areas change or recede, the ducking areas will also change. The future of these clubs is perhaps largely in the hands of the club members themselves, and coöperation between the clubs and the State and Federal Governments is the first requisite toward public confidence.

Baiting on an intensive scale has entirely altered the sport of duck shooting here as well as elsewhere. But regulation of baiting should come from sportsmen's associations and the clubs, rather than by Federal ruling.

A word about geese. Two very interesting species, the little Cackling Goose and the small Ross Snow Goose, depend almost entirely on California for a winter home; the latter may be a very rare bird some day. There probably will always be room enough in the interior valleys for such grazing species as the geese, but the development of the country will certainly contract their ranges.

Besides these we have a few large Canada honkers, the smaller Hutchins Goose, many White-fronted Geese, and Lesser Snow Geese, and a few of the rare Tule Geese. These Tule Geese are simply a large race of the White-fronted, and some authorities consider them nearly extinct at the present time.

### *The Rocky Mountain Region:*

A few Mallards winter in favorable spring holes as far north as the Mount McKinley region of Alaska. The great inland region which is mostly frozen in winter is not indicated on our map for the reason that the favorable spots are so small and so scattered that to chart them would create a wrong impression on the

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reader. A few ducks do winter as far north as British Columbia (Okanagan Lake, and other lakes and rivers which often do not freeze).

In northern Idaho some wild-fowl winter in Bonner County, Lake Pend d'Oreille region, and in western Idaho, near Boise and Nampa, and a few on the various rivers in or near the Yellowstone Park; the Shoshone, Snake, and Yellowstone, parts of which do not freeze. These are mostly Mallards. Occasionally there is quite a loss among these ducks, hundreds and perhaps thousands dying of starvation, as they did in the hard winter conditions of 1928-29 in Idaho. It is very curious that ducks so caught by severe weather sometimes fail to migrate. Black Ducks in New England are often starved and frozen in bad winters.

In Nevada there are a few ducks around springs near Ely and Ruby Lake. In Utah, several places in the eastern Great Salt Lake region hold a very few Mallard and Green-winged Teal where streams are open after all the big marshes freeze. There is also another region in western Utah (Millard County) where a few ducks stop.

Eastern Colorado holds some ducks in the Barr Lake District, where there is seepage from the large irrigation reclamation reservoirs (Prewitt Reservoir, etc.). These are nearly all Mallards, with a few Green-winged Teal, Baldpates, and Golden-eyes.

In New Mexico there are several small areas, among which is the Pecos River, near Roswell, which seems to hold ducks, besides various other small rivers, but we are now below the ice line and ducks, of course, are scattered everywhere where there is water. Oklahoma and Kansas also hold a few ducks in mild winters. The

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Panhandle of Texas is a great wintering ground when the water is abundant, perhaps one of the greatest on the continent.

### *West Indian Region:*

This region is of relatively small importance. A few of our ducks go to Cuba, but in small numbers. The Bahama Islands, of coral formation, are largely barren of ducks, although at times great numbers of scaup and teal seem to use the waterways of Andros Island. The most common American ducks in Cuba are as follows: Blue-winged Teal, Shoveler, Wood Duck, Lesser Scaup, and Ruddy. A few White-fronted Geese and perhaps Snow Geese reach Cuba, and one of the tree ducks is common there.





## CHAPTER III

### MIGRATION

OF ALL sounds that delight the wild-fowler none is more welcome than that made by the whistling wings of ducks and geese announcing that the fall migration is on. It is a signal for the inspection of guns and other paraphernalia in anticipation of the exhilarating autumn days to be spent afield.

The fact that the waterfowl are passing through on their annual flight from the breeding grounds to winter quarters is, to many, all-sufficient, but there are an increasing number of gunners who are interested to learn more about this great phenomenon. To these, we may say that while many of the salient facts are known concerning migration, particularly since the banding method has come to have such wide application, we are still far from having a complete knowledge of the complexity of detail that characterizes these great movements.

At best the subject is very complex, but probably

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nowhere in the world is there better opportunity for detailed study than in North America. When reduced to its simplest form, bird migration is a general north-and-south movement which is subject to the directional influence of the coast-lines, mountain chains, and principal river valleys. It should not be considered that these topographic features are actually responsible for the direction of the flights of the birds that follow them, but rather that they are utilized merely as a matter of convenience. This does, of course, result in heavy concentrations along certain important lines, and observers in the Mississippi Valley probably witness the passage of greater numbers and varieties of birds than could be observed in any other river valley of the world. On the other hand, great hosts of ducks, geese, shore birds, and others, sweep across the prairie States in a broad band, following no natural flyway, and in some sections ducks show no hesitation in swinging away from a north-and-south course to one that, for long distances, lies almost due east and west. This is well illustrated on the map showing the principal concentration areas, and the migration routes from and to them.

As every sportsman knows, the fall migration is usually a leisurely journey, the flocks drifting slowly southward, with long intervals of lazy loafing in favorite feeding grounds. Weather conditions in the North may do much to accelerate or retard the movement, as waterfowl if undisturbed are likely to remain almost indefinitely in an area where food is abundant, provided the climatic conditions do not shut off the supply. In another chapter (see page 183) we will relate how in the winter of 1928-29, large numbers of

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Mallards tarried in northern Idaho and western Montana until a blizzard with sub-zero temperatures cut off what had been an abundant supply of food, with the result that many ducks starved to death rather than make a flight of a few hundred miles farther south. Such cases are unusual, but they serve to illustrate the importance of the failure of the food supply in forcing the exodus from the North.

It is appropriate at this point to speak of the speed of flight and also the speed at which ducks and geese migrate, particularly since there is much misconception even in the minds of careful and conservative observers. Reports of such air speeds as one hundred miles per hour are not infrequent, the calculation usually being based upon the known velocity of a charge of shot, the estimated distance of the duck, and the estimated 'lead' that was allowed to make the kill. We grant that if all three figures in the equation were correct, the speed of the bird could be determined with fair accuracy, but unfortunately it is a fact that the great bulk of the ducks that are reported as killed at forty or even up to sixty and seventy-five yards actually are shot at about half that distance. To sight along a gun barrel and correctly estimate the distance of a moving object is so near an impossibility that we doubt if there are many shooters in the country who can do it consistently. In general the average flying speed of ducks and geese is between forty and sixty miles per hour. True, all of them on occasion exceed these speeds, but it should be recalled that the old Curtiss airplanes used in training camps during the World War, which had a maximum speed of seventy-five to eighty miles per hour, repeatedly overtook and







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literally flew through flocks of ducks which it may be supposed were making every effort to escape.

The speed of migration is quite a different matter, and, as we have already stated, the autumn flight is likely to be performed leisurely, trips of a few hundred miles being alternated with periods of resting and feeding in favorite areas. Some indication of this is found in the records of banded birds. If we take only the groups of data from birds banded during the autumn and select the shortest elapsed periods of time between banding in the North and recovery in a more southern region, we find that usually a month or more will be required to cover an airline distance of a few hundred to a thousand miles. Occasionally much greater speed will be shown. For example, a Mallard banded at Crane Lake, Illinois, was killed two days later at Lake City, Arkansas, an airline distance of about three hundred and ten miles, while another banded at the same time and place was captured six days later at Ripley, Tennessee, also about three hundred and ten miles distant. Among the hundreds of records that are accumulating in the Biological Survey, such rapid flights are unusual, and with few exceptions all thousand-mile flights have required at least a month. Among the exceptional cases is the record of a Black Duck banded at Lake Scugog, in southern Ontario, which was killed twelve days later at Vicksburg, Mississippi, an airline distance of about a thousand miles. Even this indicates an average daily flight of only eighty-three miles, or what would be covered in about two hours' actual flying time. Another Black Duck from Lake Scugog was recovered near Dallas, Texas, about twelve hundred miles distant, twenty-two days after banding.

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With the approach of spring we find some species, such as the Canada Goose, Mallard, and Pintail, pushing eagerly northward, advancing as rapidly as the retreat of winter will permit. In fact, so rapidly do they travel that it is not infrequent for them to be overtaken by a belated storm, which will cause them to wander disconsolately over frozen lakes and marshes searching for food, but seemingly without any intention of retracing their flights. At this time all or most of the birds are mated, and their actions appear to be governed by an almost uncontrollable urge to reach the breeding grounds. Other species, such as the Blue Goose and the Blue-winged Teal and Cinnamon Teal, seem quite content to remain in their winter quarters until assured of equable conditions in their breeding areas. These delicate little teals may be counted upon to arrive at least a month after their more hardy relatives have become common. With the exception of the Brant (*Branta bernicla glaucogastra*) most North American ducks and geese are believed to follow the same routes in both spring and autumn. The Brant follows the Atlantic coastline north to the Gulf of St. Lawrence, thence almost due north to its breeding grounds. In spring it is practically unknown in the interior of Canada, but in the autumn the principal flyway is along the western shore of Hudson Bay, thence southeast to the Atlantic Coast. The annual course is accordingly in the form of a great ellipse that is probably three thousand miles long by a thousand miles wide. Elliptical routes also may be followed by other species in certain regions.

In indicating flight lines on the map, extensive use has been made of the records from banded birds, but

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other sources of information also have been used. The principal flyways of the North American continent are, from east to west, the Atlantic, the Mississippi Valley, the Great Plains, the Rocky Mountains, and the Pacific. In considering these great arteries of migration they should not be thought of as narrow paths, but rather as broad highways which in places coalesce to form boulevards.

The Atlantic route is comparatively short, and in its northern portion it is important chiefly to the sea ducks, as the Eiders and Scoters. These are hardy species that breed in Labrador, on the coast of Greenland, in Southampton, Baffin, and other islands of the Arctic Archipelago, as well as in the interior to Great Slave Lake, Athabaska Lake, and north to the Arctic Coast. Those that nest in the eastern part of this great region merely move southward along the coast and in the vicinity of the Gulf of St. Lawrence and the Bay of Fundy are joined by the more western breeders which have flown southeastward across the southern end of Hudson Bay. Sometimes in winter these ducks are enormously abundant off the coasts of Massachusetts and New Jersey, but thin out rapidly after reaching Maryland and Virginia. The Black Ducks that breed in eastern Quebec, the Maritime Provinces, and New England, also use this flyway at least in part. Those that in autumn gather in the coastal ponds and marshes, make short flights. Extensive banding operations near Bar Harbor, Maine, have shown that they rarely go south of Maryland and Virginia, while many appear to winter in the region where they were banded. Sometimes the Blue-winged Teal and other shoal-water species will be abundant for short periods in



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autumn on the coast of Maine, which point has probably been reached after a southeasterly flight from the interior.

These flight lines from northwest to southeast are not thoroughly understood, but it should be noted that except in the extreme West they figure more or less prominently in all flyways. Even those routes that are chiefly due north and south take diagonal directions for portions of their lengths.

The Atlantic flyway receives accretions from at least two other important cross-country routes which strike the coast in the vicinity of Delaware and Chesapeake Bays, and on the coast of South Carolina. The first of these is the most important, as it includes the great flights of Canvas-backs and Redheads that have come across Canada from as far as Lake Athabaska, following the general southeast trend of the Great Lakes, and apparently crossing the Alleghanies over Pennsylvania. Black Ducks, Mallards, Blue-winged Teal, and others, that have gathered in southern Ontario during the autumn season, seem to leave these feeding grounds and proceed southwest over a course that is apparently headed for the Mississippi Valley. Many continue this route down the Ohio Valley, but others, upon reaching the vicinity of the St. Clair Flats, Michigan, swing abruptly to the southeast and crossing the mountains reach the Atlantic Coast south of New Jersey. This is beautifully demonstrated by the records of ducks banded at Lake Scugog, Ontario.

The Canada Geese that winter abundantly upon the waters of Back Bay, Virginia, and Currituck Sound, North Carolina, also reach the Atlantic Coast over this route. The records of those banded by Jack Miner at

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Kingsville, Ontario, show that the principal breeding grounds of his birds are among the islands and on the eastern shore of Hudson Bay. From this region they move south in the autumn, and since Mr. Miner has furnished such bountiful feed, his sanctuary has become the gathering point for constantly increasing numbers. The flight is, however, finally continued, and while occasionally one is recovered as far west as the Mississippi Valley, the majority are reported from Virginia and North Carolina, indicating that with the Lake Scugog ducks, the Atlantic Coast is reached in the vicinity of Chesapeake and Delaware Bays.

The other east-and-west lane to the Atlantic Coast is but little understood. Nevertheless several shoal-water ducks, such as the Blue-winged Teal, banded in the saw-grass marshes of South Carolina, have been recovered in Tennessee and Kentucky, when they were apparently *en route* to the Mississippi Valley, while all other individuals of this species banded at this point, and which have been retaken, either were back at the banding station or were in States of the Mississippi drainage north of Missouri.

As we have indicated in the opening paragraphs to this chapter, the Mississippi and tributary valleys constitute the most important flyway on the North American continent. Considered in its full length we find that its northern terminus is on the Arctic Coast in the regions of Kotzebue Sound, Alaska, and the mouth of the Mackenzie River. Trending a little east of south, the route lies through the great lake system of central Canada, where it is joined by the one from the central Arctic coast, and as the migrating flocks move over the vast breeding grounds of central and

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southern Canada and the northern United States, their numbers are constantly augmented. When the headwaters of the Mississippi and Missouri Rivers are reached, the route follows these streams to winter quarters in the South. This flyway is easily the longest of all North American airways. It is followed by the majority of the Mallards and Pintails, and is of importance to many other species, including both the Blue-winged and the Green-winged Teal, and some of the diving species, such as the Ring-necked Duck.

The Black Duck is thought to be extending its range westward, and birds banded at Lake Scugog, Ontario, have been retaken in Manitoba and Wisconsin. It would accordingly seem certain that some members of this species that use the Mississippi Valley flyway come south with the Mallards from South-Central Canada and the North-Central States. It is evident, however, that most of these birds that are found in the lower part of the Mississippi Valley have come in from Ontario, crossing into the United States in the vicinity of western Lake Erie and following the Ohio Valley southwest to the main flyway.

Another species that reaches the Mississippi Valley from the northeast is the Blue Goose. Breeding in the Fox Basin region of Baffin Island, these birds work south chiefly along the eastern shore of Hudson Bay, and upon reaching James Bay take off for what is practically a non-stop flight to the great coastal marshes of Louisiana, west of the delta of the Mississippi River. In some seasons flocks will make an intermediate stop among the islands and sandbars of the river, as they are occasionally common in the general vicinity of Memphis, Tennessee. The bulk of the birds



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push on to the coast, however, and during the period from November 1 to April 1 fully ninety per cent of this species is congregated in the area between the Mississippi and the Sabine Rivers. This trend of a migration route is distinctly exceptional as applied to the eastern part of the continent, as the Blue Goose apparently breeds entirely east of Hudson Bay and winters west of the Mississippi River, so that, while in passing from one to the other the general course is almost due north and south, they also pass over at least twenty degrees of longitude.

We have referred to the offshoot from the Mississippi flyway across the mountains to the coast of South Carolina. So far as present knowledge goes this is the only important branch route that leaves this main course.

While almost all migration highways are broad, we find that the extreme width is reached on the Great Plains. The prairie lakes and marshes have always been favorite feeding grounds, so it is not surprising to find great hosts of wild-fowl sweeping across the plains in a band that extends eastward from the foothills of the Rocky Mountains until it merges with the flight following the Mississippi Valley. This route in general is almost due north and south. The constituent flocks may come from breeding grounds north to the Arctic Coast and have as their destination the coastal marshes of Louisiana and Texas, or even south to the Valley of Mexico.

The Mountain route, as such, cannot be considered of first importance, as relatively few waterfowl follow for great distances the line of the Rocky Mountains. It serves chiefly as a boundary between the Great Plains and Pacific routes and is of interest principally



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in a consideration of the branch routes that cross the mountain chains to reach and join these two great flyways. A few Barrow's Golden-eyes and Harlequin Ducks do seem to follow it with fair consistency. In the autumn great numbers of Mallards and other ducks, as well as geese, follow down the eastern foothills in Alberta and gather in western Montana. At the National Bison Range, located near Moiese, several thousand of these wayfarers have been banded, the resulting returns showing not only their breeding grounds, but also the continuation of the routes to ultimate winter quarters. The majority of the birds cross the mountains through northern Idaho and continue west across southern Washington to a point roughly indicated by the junction of the Willamette and Columbia Rivers, where, joining the stream of the Pacific flyway, they proceed south to the great interior valleys of California. Another quota travels southeast across Wyoming, Nebraska, and Kansas, merging with the flocks using the Great Plains as their flyway.

The extensive marshes at the north end of Great Salt Lake, Utah, form another congregating point, the local breeders being joined by southbound flocks from more northern areas. These last have apparently started their journey by way of the prairie flyway, but leaving this they swing southwest, probably across the northwestern corner of Wyoming, to spend a few weeks in the great saline marshes of the Mormon State. From this point the advance of winter finally drives them on, and we are presented with a picture of dispersal starting in opposite directions. The majority take a southwesterly course across northern Idaho to the Sacramento and San Joaquin Valleys of California. In fact,

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the evidence of the bands indicates that the Bear River marshes of Utah supply California sportsmen with the majority of their Redheads and Pintails.

Another route from the Bear River marshes starts almost due east, but almost immediately branches, one fork turning south through Colorado and New Mexico, while the other continues east across the mountains and turns south and east through eastern Colorado and the Texas Panhandle to the marshes of the Texas coast.

The little Ross's Goose (*Chen rossi*) has a migration route that is comparable to that of its cousin, the Blue Goose, since it also is west of south instead of east. The exact breeding ground is still unknown, but probably is located on Victoria Island and possibly other islands of the Arctic Archipelago. From there, the principal flocks move south to Great Slave Lake and Lake Athabaska, thence to central and western Montana, where, turning southwest, they cross the mountains to winter quarters in central and southern California. Like the Cackling Goose, its winter range is much circumscribed, and consequently there is great danger of its complete extermination from overshooting.

The Pacific route has its origin chiefly in Alaska. Some of the Scoters and other sea ducks of the North Pacific region, together with the diminutive Cackling Goose that breeds in the delta of the Yukon River, use the coastal sea route for all or most of their southward flight. The flight of the Cackling Goose, as shown by return records from banded birds, may be cited. Geese banded at Hooper Bay, Alaska, have been traced south across the Alaskan Peninsula, and the Gulf of Alaska, to the Queen Charlotte Islands, the

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birds apparently following the coastline south to near the mouth of the Columbia River, where the route swings to the interior for a short distance, before continuing south by way of the Willamette River Valley. Winter quarters of the Cackling Geese are principally in the vicinity of Tule Lake, on the Oregon-California line, and in the Sacramento Valley of California. A few also have been recovered south to the San Joaquin Valley.

From evidence now available it appears that the great majority of the ducks and many of the geese that winter in California reach that State by way of the mountain routes already mentioned. Some pass on to winter in the Imperial Valley around Salton Sea, the mouth of the Colorado River, or even on to points on the west coast of Mexico.

After reaching a wintering region, waterfowl may not remain in one area, but instead are likely to spread out extensively. This is well illustrated in the case of the birds that proceed to the Gulf Coast. It is noticeable that ducks banded during the autumn months in Illinois have been recovered during the same season from points along the coast of Florida, Louisiana, and Texas. A Lesser Scaup Duck banded at the Paul J. Rainey Wild Life Sanctuary, Louisiana, in December, 1929, was killed six days later on the coast of Georgia, while others of the same species were recovered at short intervals between these two points. Such flights probably represent nothing more than movements from one feeding ground to another.

Before leaving the subject of migration, we call attention to another interesting and important fact that has been demonstrated by the return records from

*Cackling Goose*

*Canada Goose*

*Hutchins Goose*









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banded waterfowl. Briefly stated, it appears that individual ducks and geese are remarkably constant in following their migratory flyways. This 'homing instinct,' which has been appreciated only so far as concerned breeding areas, applies also to winter quarters and the routes to and from them. Operators of trapping stations located in all parts of the country have repeatedly recaptured ducks banded by them in previous seasons. Even if somewhat scattered out during migration, individuals do not ordinarily stray far from their proper flyway.

The practical significance of this fact will be obvious when it is remembered that the terrific mortality of wild-fowl from poison and disease *has been almost entirely at points in the West*. As a result, while ducks were abundant in the Mississippi Valley and on the Atlantic Coast, bad seasons have found them noticeably scarce in Western marshes, with sportsmen and conservationists loud in urging reductions in bag limits or other restrictive legislation directed against shooters in all parts of the country. It is our belief that such action will do little to restock the West so long as these plague spots remain, for the birds themselves will continue to return to their traditional breeding and wintering areas over the same routes. In other words, poison and disease might actually exterminate the waterfowl in the West, while at the same time a constant increase in their numbers might be witnessed in the East, which increase would be exceedingly slow to overflow and repopulate the devastated areas west of the one hundredth meridian. Man can do much to improve the conditions for waterfowl, but he can do little that will affect their seasonal movements.





PART II  
ADVERSE FACTORS





## CHAPTER I

### DRAINAGE AND IRRIGATION

NO PROBLEM to-day so vitally affects the future of our wild waterfowl as the drainage of swamps and marshes. Also no policy that, while ostensibly aiming at the betterment of human welfare, is frequently so utterly fallacious.

The result usually sought by promoters of drainage enterprises is to produce good farm land from land too wet for ordinary agricultural purposes. This can sometimes be done, and in many cases it has been done. Engineers and promoters are always able to cite instances where the removal of excess water has resulted in valuable farm land, so it is well to state frankly that occasionally drainage has been entirely successful. These time-worn cases do not, however, in any way detract from the importance of the question, and, even while admitting their success from the viewpoint of the cereal or truck farmer, it is pertinent to inquire whether or not the value of the water or wet



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land crops that could have been raised might not have been greater without the tremendous expense of drainage.

As a Nation we have been dealing with our marshes much as we have with a great many other natural resources — acting first and considering the consequences later. It is to be hoped that the time is not far off when there will come into existence, a National Fact-Finding Commission, with adequate authority to investigate and make strong recommendations in connection with all public drainage and related projects. Because of the vast amount of capital that is invested in such projects, the suggested commission would require strong and comprehensive State laws to enable it to function properly and stop the waste of unwise drainage. Its membership should include not only reclamation engineers and economists, but also conservationists and wild-life experts, and its services should be available for expert advice on National, State, and private enterprises. To eliminate, as much as possible, all political aspects, it is believed that the commissioners should be appointed by the President and serve without pay in a manner similar to the Advisory Board of the Federal Migratory Bird Treaty Act.

A recognized principle in agriculture is that plants thrive best on land on which the same or closely allied species have grown naturally, and the failure to recognize this fact has caused many of the largest drainage enterprises to be the most hazardous and the most wasteful, in capital and labor, of all agricultural projects. The uncertainty of these projects also is frequently caused by a total lack of consideration of the

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quality of the land that will be available when the water is drawn off; of the comparative value of the crops that might be raised upon the marsh in its natural state and the relation that they would have to the maintenance of proper conditions in the surrounding country; of the economic loss to the Nation of the nurseries for game birds, fish, and fur-bearers; of that vital consideration, the lowering of the water table, with its resultant effect upon the productivity of the surrounding regions; or of the increased fire hazards that exist in drained marshes and bogs. For the purpose of illustration, it is well to consider each of these factors in detail.

Experience has already demonstrated that drained marsh land may result in top soil of two kinds, one that is entirely worthless for agricultural purposes, being nothing more than acid cellulose from which the organic matter has been leached out; while the other may present such an excess of organic matter as to constitute an unbalanced plant ration. Wonderful crops can be, and frequently are, raised for a few seasons on land of the second class, until the plant food becomes exhausted and the land requires the addition of fertilizer. Pictures of crops growing on lands of this type are usually used by drainage promoters to further their claims for additional enterprises. Some reclaimed marsh land is so rich in organic matter, being in fact nothing more than a layer of decayed vegetation, devoid of mineral content, that it is suitable only for peat, a type of fuel not likely ever to become popular in America. Under this layer the prospective farmer is frequently further disillusioned to find only clean, white sand, the bed of an ancient stream or lake.

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Crops suitable for swamps and marshes are many and varied in character. It can be stated without fear of successful contradiction that in some Northern marshes, an annual crop of beaver, mink, muskrats, and other fur-bearers might be harvested that would have a value in excess of the customary crops that a farmer would raise on an equal area. Also, the expense of production would be comparatively small. Marshes and swamps abundantly stocked with native food-plants sought by migratory wild-fowl will attract these birds in large numbers and bring in a stream of revenue to the owner who, under a judicious system, could lease or rent shooting privileges to sportsmen. In addition, this same area would yield a valuable annual return in fur.

Muskrat skins have become a dominating factor in the fur trade and are likely to remain so. At the present time there are literally tens of thousands of these animals taken each year from the great coastal marshes of Louisiana, the value of which probably far transcends that of any other crop that could be raised in that region. In fact, annual fur crops from that State have actually exceeded that of the combined provinces and territories of Canada, the region that is popularly supposed to be the chief source of furs for the continent. In addition to its fur the flesh of the muskrat (which is not a rat at all) is preferred by many to rabbit. It has been canned under the name of 'Marsh Rabbit' and without doubt a suitable market can be developed. It was estimated that the value of the muskrat crop in 1922 from the marshes in Dorchester County, Maryland, was about \$250,000, while during the ninety-day trapping season of 1928-29, one

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well-managed reservation in Louisiana yielded 25,000 muskrats from 26,000 acres of marsh, not to mention mink and raccoon. The average value of the muskrat skins for that season was a few cents more than one dollar and the superintendent predicted that in the season of 1929-30 the catch would be 40,000. Probably many refuges or shooting preserves for wild-fowl could be made more or less self-supporting through proper administration of their fur resources.

Other crops, such as some of the marsh-loving plants which have for centuries been food staples for some peoples in the Orient; fish, crawfish (fresh-water lobsters), turtles, and waterfowl are all raised on marsh lands with a minimum of labor and capital, and a maximum return.

History has already recorded the trials, tribulations, and successes of the dry farmers of yesterday, who conquered the desert regions of the West, and, unless their opportunities are ruined by lack of National foresight, it will similarly resound with the more remarkable achievements of the 'wet farmers' of tomorrow. Already the Bureau of Fisheries is maintaining an experimental station at Fairport, Iowa, for the purpose of increasing pond productivity. In both large and small ponds fish food-plants are increased through the use of such fertilizers as sheep manure, superphosphate, soy bean meal, and shrimp meal, the algæ produced being the natural food of the small minnows that in turn furnish food for black bass. Aquiculture, although lacking the ancient lineage of agriculture, can be made even more remunerative.

The economic loss to the Nation, through the de-



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struction of the natural resources in swamps and marshes, is incalculable. At present it is estimated that more than 7,000,000 persons in the United States hunt game each year. Continued drainage is threatening the very existence of some forms of this recreation on which some of our highest type of citizenry depend for the development of their resourcefulness and the maintenance of the physical and mental health which is of the utmost value in relation to their civic usefulness.

It has been further estimated that at least \$50,000,000 are spent each year by sportsmen in harvesting the crop of game. This vast sum goes not only for the purchase of guns and ammunition (which, in fact, are minor items), but finds its way into many other lines of industry which profit from the money spent by the sportsmen for clothing, boats, rubber goods, decoys, other hunting equipment and paraphernalia, transportation, and subsistence. The marsh areas are an integral part of the playgrounds of the country and as such they are entitled to perpetuation.

The effect of drainage upon the water table has been demonstrated. Marshes and lakes frequently serve as the source of supply for the sub-surface moisture upon which depends the success or failure of crops in adjacent areas. When the water table has been unduly lowered, plants are unable to root deep enough to secure the water necessary for their growth. In this way the drainage of a marsh may cause the failure or partial failure of crops on land for a great distance around it. Springs and wells also are frequently lowered or caused to go dry.

In some parts of the country there is a greatly in-

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creased danger from fire as a direct result of drainage. Formerly, when forests and prairies were intersected by countless lakes, streams, and marshes, a fire usually ran but a short course before encountering a natural barrier. Now all is changed over vast areas. Many lakes are dry and millions of acres of peat swamp have been drained and converted into veritable fire-traps. Fire starts very easily in dried peat, since the pulverized, sun-dried vegetable humus makes excellent tinder that ignites readily from a carelessly discarded cigar or cigarette butt, a match, or from lightning. Moreover, drained peat swamps will carry fire deeply concealed for long periods, even over a winter season. Such fires are not unlike the well-known fires that occur in abandoned coal mines, and they may break out when conditions are favorable, run rapidly along the surface, and enter upland forests. The great fires of 1918 in Minnesota, which resulted in the death of 432 persons, and damage to property running into many thousands of dollars, were started in just this way.

Another aspect of the drainage problem deserving serious consideration is the fact that frequently the land proposed to be reclaimed is not needed. There is obviously no reason for bringing more land into agricultural uses, unless there is a growing demand for an increase in quantity of the products of the soil. Such a demand depends naturally on the growth of the population, the foreign markets, and the purchasing power of the Nation and the world at large. Due to the invention of labor-saving machinery and a vast improvement in agricultural technique there is resulting an increased production both per man and per acre. This, in turn, is reducing the demand for more farmers

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and more farm land. It should be remembered that as a business man the farmer is engaged in a competitive occupation, and it is a sound axiom in business practice that if too many people engage in any competitive business there will be overproduction and consequently a period of stagnation and depression.

At present the problem of American agriculture is how to avoid crop surpluses, not to search for means of increasing them. Furthermore, it should be borne in mind that the greatest number of demands for reclamation work of all kinds come not from prospective farmers, but from chambers of commerce and similar organizations, that are concerned chiefly with increasing business for their local promoters and merchants rather than the welfare and prosperity of the settlers who might go on the new land.

Writing in the 'Atlantic Monthly' for May, 1925, Sir Daniel Hall says that in a self-sustaining country only about ten per cent of the people are needed to feed the Nation. The United States Department of Agriculture has calculated that the addition of only 40,000,000 acres of crop and pasture land will be needed to support the estimated population for 1950, that is, 150,000,000. In his annual report for 1918, the Secretary of the Interior, writing on this subject says: 'In New York land by tens of thousands of acres has been deserted and is advertised by the State, which will produce apples and other fruit of fine quality besides all the staple cereals and vegetables, but which does not attract as against the distant and alluring lands of the West.... Within fifty miles of the city of Washington, both in the States of Maryland and Virginia, there are



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large bodies of land which were once parts of great plantations that can be had for less than any land within the same distance of most of the larger cities of the West. The mind of the country has turned toward the development of raw lands...to the neglect of opportunities nearer the center of the country's markets...yet between this city [Washington] and New Orleans there are over 40,000,000 acres of unused lands.'

Figures compiled and released by the Department of Agriculture in March, 1927, showed a cropped area in the United States of about 350,000,000 acres, with an estimated total of more than 600,000,000 acres, still available. Of this, nearly 500,000,000 acres require neither irrigation nor drainage, so it is obvious that, without reclaiming an additional acre, our present crop area can be more than doubled. In 1925 it was estimated that there was enough drained land to provide for normal expansion for a period of thirty-five years, without starting any new projects.

The Bureau of the Census and the Bureau of Public Roads estimated that in 1922 organized drainage districts in the United States included approximately 75,000,000 acres, a region larger than the combined areas of the Great Lakes, or half again as large as all New England. With the water drained or draining from this vast territory, is it not proper to pause and make inquiry concerning the effect upon our natural wild-life resources?

The great amount (more than \$18,000,000) that the Federal Government has decided to write off as a definite loss on its irrigation projects is unquestionably paralleled by similar drainage enterprises, for the

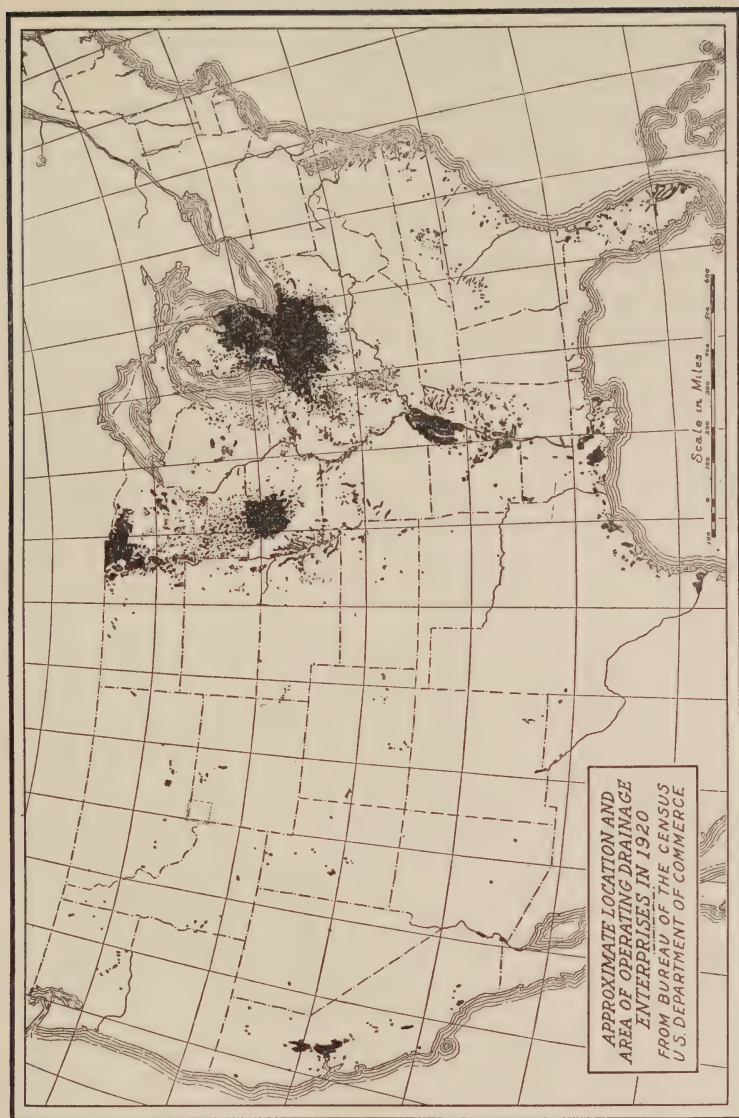


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reason that by and large only a relatively small amount of drained land is actually under the plow. The exact figures are not so readily obtained, since, by the Swamp Land Acts of 1849, 1850, and 1860, provision was made for ceding public marsh lands to the various States upon their application for them, and in consequence drainage of such areas has been largely or wholly outside of Federal control. Nevertheless, it is definitely known that, from the viewpoint of successful agriculture, many drainage districts, that were organized and operated at great cost, have been partly or wholly failures, either by virtue of the impossibility of complete drainage or because of the nature of the soil exposed. It would seem reasonable at least to demand that these blunders be rectified before further encroachments are made upon the marsh lands of the country. Also, it should be remembered that when a drainage project is a failure and the State or National Government is induced to buy back the land, pay the assessments due, or otherwise cancel the indebtedness, it becomes a case where the general public is made to pay the promoter his undeserved profits.

The great part that is played by swamps and marshes in the matter of flood-control should not be overlooked. While the preservation of these areas is not offered as a panacea for these devastating calamities, still it must be apparent to every one familiar with the conditions that such natural reservoirs are important factors in regulating the run-off from the great watersheds.

The case presented by a study of the Mississippi system is outstanding. According to the Census Report for 1920, three fourths of all the land in drainage





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enterprises in the United States is situated in those States north of the Ohio and Missouri Rivers and east of the Rocky Mountains, including Missouri and Kansas. This also is well shown by the map. It is recognized that these projects have to do, not only with the drainage of lakes and swamps, but also with boggy meadows and other land that, while not actually marshy, is still too wet for successful agriculture. Nevertheless, it is a subject for sober thought that the waters from three fourths of the drainage enterprises of the country ultimately reach the Mississippi River. With tens of thousands of miles of ditches to facilitate the run-off from the greatest watershed on the continent, all pouring their waters into a common stream — mighty river though it be — the economic loss in life and property through the inevitable floods becomes more readily understandable.

The part played by irrigation may be summed up briefly. This human activity is, from the viewpoint of waterfowl, both a boon and a curse. The detrimental effects, which are confined almost entirely to the West and Northwest, are similar in every instance, namely, the destruction of swamp and marsh areas through the cutting-off for irrigation purposes of the source of water-supply. Possibly this result is inevitable, as it must be admitted that an adequate water-supply is imperative to successful agriculture. At the same time, the attention of sportsmen and conservationists should not be diverted from the disastrous results of such operations upon certain breeding, feeding, and wintering grounds.

It would seem possible to work out coöperative arrangements with the residents of such agricultural



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communities, whereby a supply of water may be permitted to enter lakes and marsh areas sufficient to maintain their levels and so assure their utility as homes for wild life. Here, again, is a problem the solution of which would seem to depend entirely upon a spirit of mutual understanding and the recognition of the interests of the agriculturists, the conservationists, and the sportsmen.

With the foregoing account as a background, it becomes pertinent to look further into the matter and present a few examples that are illustrative of conditions in some of the States that have suffered most heavily from the drainage mania. But little attention need be paid to the enterprises that from a purely agricultural viewpoint have been successful, for, as we have previously stated, such cases are well known, and it is our purpose to direct attention to some of the failures or partial failures, with their attendant effects upon our wild-fowl population. Obviously, it has not been practicable to give detailed accounts of all unwise projects, but rather our aim has been to give special attention to those States wherein these activities have constituted a serious menace to the future of wild-fowl, and to cite such outstanding cases as will show the vital importance of this question.

*Arkansas.* — Most of the drainage work in Arkansas has been for the reclamation and improvement of the so-called swamp land in the alluvial bottoms of the Mississippi River, a region that we have already shown to be one of the country's most important wintering areas for waterfowl. Much of this land still supports considerable stands of merchantable timber, although large areas have been logged off. The area included in

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operating drainage enterprises amounts to more than 7,000,000 acres, or about twelve per cent of the total land area of the State. In 1925 a prominent sportsman of Memphis, Tennessee, writing of these bottom-land marshes, gave as his opinion that in the preceding seven or eight years drainage had reduced good duck country at least fifty per cent.

A report submitted to the Biological Survey in October, 1927, stated that drainage projects in Mississippi County, in the northeastern part of the State, were 'a miserable failure.' Previous to drainage this entire county had valuable natural resources in fur, fish, and game; now it is ruined for these animals, and the reclaimed land has not proved good for agriculture. Land that adjoins the drained areas used to produce good crops, but the seepage, induced by drainage, has taken so much moisture out of the soil that it has ceased to be productive. In some instances production of some crops has decreased one third. According to this report thousands of acres are now considered agriculturally worthless and are being sold for taxes. Walker and Buford Lakes, with an area of about three thousand acres, have been completely dried up.

A statement, prepared by the county surveyor of Arkansas County, and included in this same report, shows in twenty districts the drainage of 74,773 acres for which an average tax of \$1.63 per acre has been imposed for a period of twenty years. This tax is in addition to other taxes already existing.

The country around Big Lake (a Federal Bird Reservation) has been so affected by drainage that, even under the protection of the Federal Government, this lake was in serious danger of passing out of

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existence. The encircling drainage ditches have so cut off its sources of supply during the dry seasons that winter rains are frequently insufficient to bring it up to the normal stage.

The local sportsmen and game officials are, however, awakening to a realization of the situation, which is graphically illustrated by a consideration of the case of Horseshoe Lake, an 'ox-bow,' located in southeastern Crittenden County, about twenty-five or thirty miles from Memphis, Tennessee. The lake is about eight miles long by from one to three miles wide, and bears a wonderful reputation as a ducking ground. Two wealthy landowners, with adjoining holdings, dug a ditch by means of which the level of the lake was being seriously lowered, when the matter was taken up by the hunting and fishing clubs of the district. They obtained the coöperation and support of the State Attorney General and the Arkansas Fish and Game Commission. On May 18, 1928, Judge G. E. Keck granted an injunction to stop the drainage and the preservation of one of the State's most noted wild-fowl resorts seemed assured, but, unfortunately, the State Supreme Court, by a four to three decision, reversed the judgment of Judge Keck so that the drainage of Horseshoe Lake continued. To prevent its complete spoilage a movement was started in 1929, by five outing clubs and other interested organizations and individuals, to acquire the lake and make it a Federal Refuge.

*California.* — With the possible exception of Utah (because of the great Bear River marshes), California easily occupied first place among the Western States in its relative importance to ducks and geese. Old maps indicate a belt of marsh land that extended from one



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end of the Great Valley of California to the other, a region that furnished food and cover for multitudes of wild-fowl, while numerous lakes, both large and small, supplied resting and 'loafing' grounds. In 1911-13 the Sacramento and San Joaquin Drainage District was created by a special act of the Legislature, the area included being the low land along the Sacramento, San Joaquin, and Feather Rivers, from Butte and Glenn Counties on the north to Fresno and Madera Counties on the south. The Board of Reclamation, appointed by the Governor, has large powers, and in 1929 Dr. H. C. Bryant, of the State Division of Fish and Game, estimated that *marshy areas had been reduced at least ninety per cent.*

Buena Vista Lake, in the southern part of the San Joaquin Valley, is practically dry, and the small area of open water remaining seems to present unfavorable conditions for ducks. Since 1908 large numbers of birds have each year died of disease at this point.

Tulare Lake, at one time the largest body of fresh water in the interior valley, has now been dry for several years. Originally, this lake was reported to have had a water area of about two hundred and seventy-five square miles and was a favorite winter loafing ground for ducks. Here irrigation has been the chief causative factor. By 1914 drought conditions, evaporation, and the cutting-off for irrigation purposes of the tributary flow had wiped the lake out of existence. In 1922 it was filled to a depth of eight feet, but went dry again in the same year and has since remained so. A great part of the lake-bed is now a dry, dusty flat.

In the northeastern part of the State, Lower

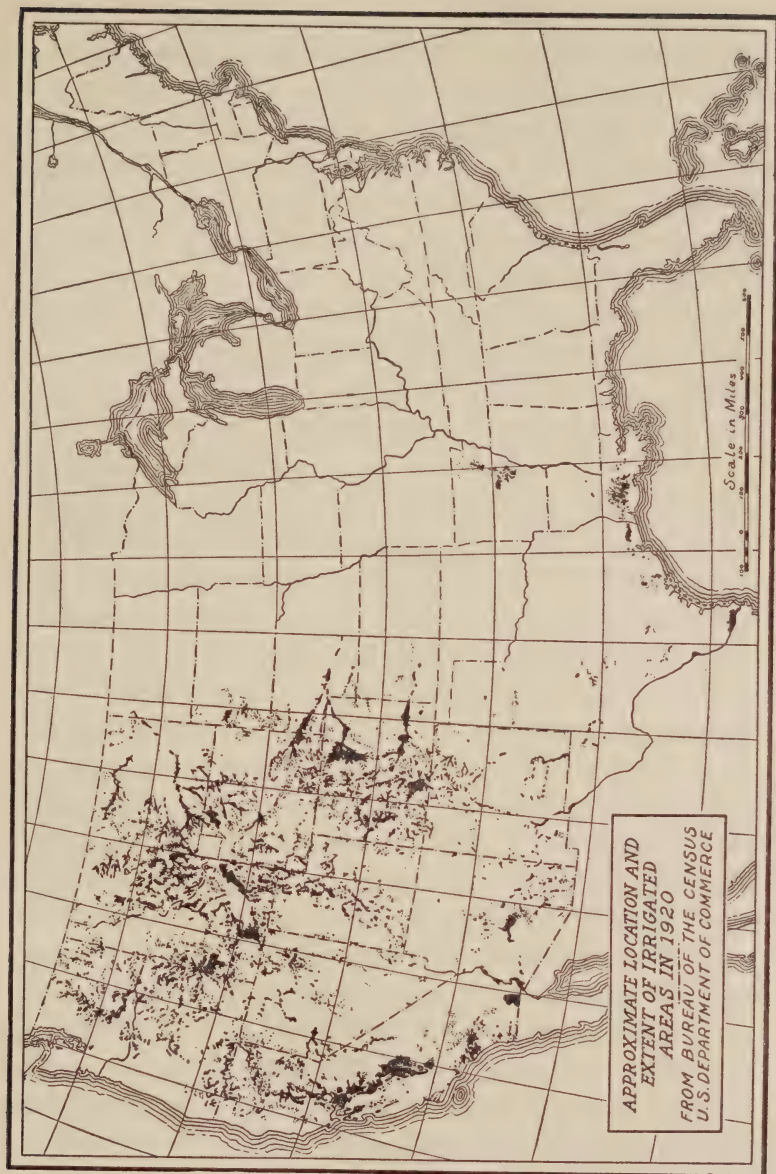


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Klamath Lake presents another example of an excellent wild-fowl area that has been destroyed by cutting off its supply of water. Prior to 1917 backwater from the Klamath River entered the Klamath Basin, producing a great region of marsh and the Lower Klamath Lake. When the Southern Pacific Railroad constructed a grade across the marsh, it was provided that a gate should be built to cut off the inlet where the railway crossed it. This was done, and the result has been the drying-up of the lake and surrounding marsh. Very little of the land uncovered has proved valuable agriculturally, and were it not for Government aid, this project probably would have been abandoned a long time ago. The cost of production has been excessive and 'breaking even' is about the best agricultural record for the area. The only water that now flows into the basin is a small amount from a spring in the western part. This is just sufficient to maintain a small pond known as 'Sheepy Lake,' and we learn that, not satisfied with the destruction already wrought, plans are being considered for the drainage of this last remaining water area.

Tule Lake, a few miles east of Lower Klamath, has suffered a similar fate, as its source of water-supply is now practically all taken for irrigation. Some water does remain in the 'sump,' and as this lake has recently (1929) been proclaimed a Federal Bird Reservation, it is hoped that it can be restored to its rightful condition. It is of great importance since it is one of the two principal wintering grounds of the diminutive Cackling Goose, a fact that was demonstrated through the banding of these birds on their breeding grounds in Alaska.

In summation it may be said that throughout the





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length and breadth of this great State many areas have been despoiled by drainage and irrigation activities, until to-day probably the best of the remaining marsh lands available for ducks and geese are those owned and maintained by the duck clubs. A rift in the clouds is, however, provided by the recent action (1928) of the State Legislature, which passed an act providing that one third of the revenue derived from hunting-license fees should be used to purchase game refuges. With several large reservations established and their water-rights fully protected, California may again claim the important place that she once held for the waterfowl of the West.

*Florida.* — Much publicity has attended drainage operations in Florida, chiefly because of the great magnitude of the undertaking to drain the Everglades. On this enterprise, known as the Everglades Drainage District, it has been estimated (1928) that there has been spent a sum in excess of ten million dollars for the purpose of making available for agricultural purposes an area about the size of Connecticut. In July, 1928, Governor Martin announced the collapse of a plan to finance further activities, through the refusal of the State Commissioner of Agriculture to sign bonds, the proceeds of which were to be used for this purpose. Opinions differ relative to the value of the land that has been already reclaimed, but in the vicinity of Lake Okeechobee it appears that the outstanding accomplishment by drainage has been the development of some lands that are suitable for truck gardening, while opposed to this success are miles of dead timber and land that is worthless for agriculture. A large amount of the drained land is of a sandy nature.



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Fortunately there are in this State hundreds of lakes, miles of rivers, and a very extensive coastline with its adjacent marshes that can never be affected by the operations of either drainage boards or promoters. According to the 1920 Census Report the approximate land area of Florida is a little more than 35,100,000 acres, and at that time the area involved in operating drainage projects amounted roughly to 1,600,000 acres, or 4.7 per cent of the whole.

*Idaho.* — The percentage of drained lands in this State is insignificant when compared with the total area. Nevertheless, because of the fact that the northern part, or panhandle, lies directly in an important migration route for waterfowl, it seems desirable to refer briefly to what has happened in that region.

Formerly the valley of the Kootenai River, in Boundary County, contained a series of lakes and swamps that were well suited for the breeding and feeding of wild-fowl. These have been drained and forever destroyed as wild-fowl resorts, since the areas reclaimed are rich agricultural land. This project is, in fact, one that was inevitable and fully justified from the standpoint of crop production. With the settlement of the country it was certain to be carried out sooner or later. When such results can be *definitely foreseen*, opposition of conservationists is useless, and we introduce this case merely for the purpose of illustrating one of the unavoidable effects upon our wild waterfowl of the continued advance of civilization.

Priest Lake and Lakes Pend d'Oreille, and Cœur d'Alene in this region, while affording resting places, are deep and consequently do not provide suitable nesting sites and support very little food.

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*Illinois.* — From the standpoint of migratory water-fowl, consideration of the situation in Illinois must be confined chiefly to that eastern section involving the Kankakee River, and those sections along the Illinois and Mississippi Rivers. As the Kankakee marshes will be treated under 'Indiana,' comments here will be limited to the western areas. A little more than ten per cent of the total area, or about four million acres, are involved in operating drainage enterprises in this State.

The great importance of the Mississippi Valley fly-way to ducks and geese makes of much consequence to them any operations that tend to reduce or otherwise unfavorably alter the feeding and resting grounds along this route. This is, however, exactly what is happening as the bottom lands of the Mississippi from Rock Island to Cairo are practically one continuous drainage district. There can be no question that the rich bottom lands of this stream are valuable agriculturally, but it also is true that in their natural state these marsh lands (which are chiefly hardwood timber) had a high potential value, in wild-fowl, fur, fish, and lumber. The situation in the valley of the Illinois River is further complicated by the Chicago Drainage Canal. As on the Mississippi River, an extensive series of drainage districts has been created extending from Peoria to its mouth, but at almost every flood-stage of the river, its waters, already greatly augmented by the Chicago Canal, break through the levees. In recent years, this has happened almost every year, with such heavy expense involved in effecting repairs that it seems almost certain some of the districts will be abandoned. As most of the important marsh lands are now in the hands of duck clubs, the preservation of

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this important area, for the use of wild-fowl, appears assured. It is, however, true that many important feeding areas have been ruined for ducks either by drainage or by being deeply inundated with the water from Lake Michigan. Feeding on the part of the shooting clubs is now an important factor in holding birds in this section.

*Indiana.* — The percentage of land included in operating drainage enterprises in Indiana is the greatest of any State, more than 9,000,000 acres, or 39.4 per cent of the total approximate area of 23,068,800 acres, being involved. Much of this vast region has to do only with the tile drainage of meadows and other wet lands that have little or no significance to wild life, and so may be considered as entirely legitimate projects. The figures for such areas are, however, inseparable from those that apply only to swamps and marshes. Many of these last have been drained, resulting in a considerable aggregate loss to waterfowl and fur-bearers.

The Kankakee River probably presents the most notorious example of unwise drainage on the entire continent. 'Lake Kankakee,' as this river was formerly known, extended approximately from Momence, Illinois, to a point near South Bend, Indiana, an air-line distance of about eighty miles in length, but because of the extreme crookedness of the original river channel, it traversed about two hundred and forty miles in flowing between the two towns named. The marsh area bordering this stream varied from five to ten miles in width. Previous to drainage these marshes literally swarmed with fur-bearing mammals, ducks, and geese. Each year fur and game products to the



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value of many thousands of dollars were produced and thousands of sportsmen made annual visits to the section for the purpose of enjoying the health-giving outdoor sports.

Under an act of the General Assembly, approved April 11, 1881, Governor Albert G. Porter appointed John L. Campbell, Chief Engineer, to survey the river and make recommendations for its straightening and the drainage of the marsh area. The survey was made in 1882, and the recommendations made were eventually carried out. It would be futile to assert that no part of the drained area is fit for farm purposes, as some of the section drained in this operation has produced excellent agricultural land, although the cost has been very heavy. A great part, however, of the uncovered land cannot be successfully cultivated, while its original value as a home for wild life is entirely destroyed. Estimates vary concerning the amount of good agricultural land, but some have placed it at not more than thirty per cent. It has even been said that some of the farmers who were most active in urging the passage of the Drainage Act finally admitted that it was primarily a land scheme. One farmer is reported to have said that 'seventy per cent of the land made possible by this Drainage Act is positively worthless and will not grow sandburrs without irrigation.'

Furthermore, the drainage ditch, which straightened the old Kankakee River bed and changed the stream into a swiftly moving current, has been dug to such a depth that all water, even that needed for subsoil irrigation, is either carried off in a torrent or else seeps away, so that much of the land in adjoining areas



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now fails to hold the moisture necessary for successful plant growth. In other words, the drainage ditch acts as a sink and too quickly relieves the contiguous territory of even normal rainfall. In dry seasons this has resulted in conditions that have been seriously harmful. In July, 1921, a representative of the Biological Survey examined an area (lying in the Big Beaver Lake bottom) that had that spring been plowed and planted to rye. Not a spear of rye was in evidence; hardly a weed was growing; the white sand lying as a bare waste, mute testimony to the havoc wrought by the folly of those who planned and executed this piece of drainage.

This drainage of adjacent water areas is further illustrated by the case under consideration, for, in addition to draining the river marshes, the 'Kankakee ditch' has been responsible for the destruction of some of Indiana's most beautiful lakes, namely, Pine, Stone, and Fish Trap Lakes, located near Laporte, and fully fourteen miles from the drainage ditch. After the ditch was dug, the levels of these lakes were lowered more than four feet, making two little lakes out of Pine Lake, a very small one out of Stone Lake, and completely destroying Fish Trap Lake. The water-line of Flint Lake, near Valparaiso, has receded about one hundred and fifty feet; the level of Hudson Lake, in Laporte County, is six or seven feet lower; and several other lakes have been seriously affected since the Kankakee was ditched. This provides a graphic demonstration of the sub-surface connection that frequently exists between bodies of water, and the disastrous effect upon the level of the water table that may result from drainage of natural reservoirs.

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The Kankakee drainage also furnishes an example of the way in which the general public is ultimately affected by such unwise activities. In 1926, United States Senator New received petitions setting forth the failure of this project and urging the restoration of former conditions at Government expense. This has not been done, but some holders of the drained land, unable to pay the so-called 'benefits' that were presumed to accrue from the drainage, have had relief measures passed through the State Legislature, whereby the State has taken over certain tracts, upon payment of the accrued 'benefits.' An area of this kind, in Laporte and Stark Counties, totaling about 2100 acres has been acquired by the State Conservation Department, which will use it chiefly as a bird refuge. In this case the 'benefits' paid from the State Treasury amounted to \$81,000.

It is gratifying to note that in 1924 the Director of the Indiana Department of Conservation reported a victory for conservation of the Tippecanoe River, which was in danger of sharing the fate of the Kankakee. In the fight, which lasted nearly four years, some of the Department's best allies were indignant farmers who had learned the costly lesson of 'benefits' from drainage.

*Iowa.* — Drainage operations in Iowa have been centered in the central and north-central part of the State, although areas of considerable size located along the Mississippi Valley and in the southwestern section also have been involved. In 1920 more than fourteen per cent, or an area in excess of 5,000,000 acres, was included in operating drainage projects.

In the pioneer days the lake region of northern Iowa

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and the prairie sloughs in the southwestern part constituted wonderful resorts for waterfowl, fairly comparable with the great duck lakes and marshes of Minnesota. These have been largely destroyed, until to-day the State supports but a fraction of its former wild-fowl population. While unquestionably some valuable agricultural land has been recovered, the cost has been great, and many lake-beds were found to be merely peat bogs which in their drained condition are unfit either for crops or for waterfowl. The value of the land in several drainage projects has been so little that large sums of money have been appropriated from the State Treasury to liquidate the indebtedness. An excellent example is Rice Lake, near Forest City, lying across the line between Winnebago and Hancock Counties, which originally covered about eight hundred acres, with a luxuriant growth of wild rice and other aquatic plants noted as food for ducks. It was drained in 1906. In 1923 the area was examined by a representative of the Biological Survey, who reported that '...most of the land that was drained consisted chiefly of peat, in some instances from ten to twenty feet in depth. As a whole it is a mass of wet soggy peat upon which grow rank weeds and rushes. It is even unfit for pasturing, and, in fact, it has been carefully fenced off so that the cattle will not enter and thereby lose their lives by becoming mired.' At that time the amount of open water was about sixty acres. Lake Edwards, near Britt, Lake Eagle, and East Twin Lake, near Godell, and Swan Lake, near Carroll, are similar cases of unwise drainage. It has been reported that as much as ninety per cent of the drained swamp and marsh lands in some sections of this State are unfit



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for agricultural purposes, and that in places the water-level has been lowered as much as nine feet, while the affected communities are deprived of the recreational and monetary advantages that formerly existed in these lakes and marshes.

The condition in the eastern part of the State is well illustrated by the following statement contained in a letter received in June, 1929, from Mr. Allen Green, of Oakville, who has attracted much attention through his success in holding large numbers of ducks, during severe winter conditions: 'Yes, we are through farming. Lost probably a quarter of a million dollars before we knew what a gambling game it was. I now own about one hundred acres of swamp which is worth more than the ten thousand acres of what was once called the "Fertile Mississippi Bottoms." Too bad they don't turn the water back where it always was. This fight against the elements is a losing one. It isn't a question of building higher levees, for when we were flooded the levee broke in the highest place. I've studied the question just long enough to know that every one would be better off if the levees were opened up instead of raised. Then this would give the birds and fish a chance.'

In the southwestern part of the State attention should be directed to the 'Knox-Plum ditch,' dug in 1911 at an estimated cost of \$100,000 for the drainage of sloughs and marsh land in Fremont County. Much of the land adjacent to the headwaters of Plum Creek was fairly well drained, but the lower end, where a natural drainage had permitted the raising of crops, was badly flooded through the ditch levees acting as dams and preventing a proper run-off. Also the



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sediment carried down from the hills rapidly filled the ditch, adding to the complexity of the situation. This is in the 'Wide Waters' section, a region long noted as excellent ground for duck hunting.

*Kansas.* — Comparatively speaking Kansas does not have extensive marsh areas and only two tenths of one per cent of the total land area is involved in drainage enterprises. Nevertheless, within the lines of this State there are a few sections that are of the utmost importance to wild-fowl and so should be preserved for their use. Of these the most noteworthy is the famous Cheyenne Bottoms in Barton County.

This is a depression of approximately one hundred square miles into which two water-courses, Blood and Deception Creeks (normally dry), empty flood waters. There is a trace of an outlet to the Arkansas River in the form of a depression twelve or fifteen miles long in which water seldom flows. The basin draws its name from the Cheyenne Indians, who, according to legend, won it more than a hundred years ago, after a sanguinary battle with either the Pawnees or the Kiowas.

In the late nineties a company was formed which dug a thirteen-mile ditch from the Arkansas River, emptying into the Bottoms. The scheme was to develop power at the mouth of this ditch, but it was operated only a short time when flood-waters destroyed the dam at the intake and the project was abandoned. The company did, however, run water from the Arkansas into the Bottoms, maintaining a stream for about one hundred days, and creating a large lake. In the fall of that year followed the greatest slaughter of ducks ever known in Kansas. Market

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shooters flocked to the lake and dealers made regular trips taking in ammunition and buying the ducks from the hunters. The birds were shipped in refrigerator cars from towns near by and sold in Eastern markets. Years of drought caused the lake to disappear gradually by evaporation so that even in the wettest seasons the Bottoms became little more than a swamp. Efforts to drain this were a complete failure, although farmers and homesteaders came in and did cultivate some of the land in the old lake-bed.

Such was the condition when a series of cloud-bursts in August of 1927 again caused dry water-courses to become raging torrents. When the rains ceased and the farmers began checking their land, it was found that almost overnight a lake had been formed that covered an area of more than thirty square miles, with several additional smaller lakes and ponds scattered about the Bottoms. This lake was unquestionably the largest body of water in the entire Great Plains region, and again became the resort of untold multitudes of ducks, shore birds, gulls, and other water-loving species. This great area will be drained by Nature through evaporation unless man takes a hand to ensure its perpetuation. It is therefore a pleasure to record that the Seventy-first Congress appropriated \$50,000 out of a total authorization of \$250,000 for the acquisition of 20,000 acres of land and water in this area, to be maintained as a Federal migratory bird refuge. This will enable the Bureau of Biological Survey to commence operations for its establishment at an early date.

Some smaller unsuccessful drainage projects in Kansas include the Big Slough project, the Salt Plains

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project, and the attempted drainage of a large sink in McPherson County. Failure or partial failure in these cases has resulted either from the large size of the watersheds which bring in flood-waters that the drainage canals cannot handle or the high alkaline content of the soil reclaimed.

*Louisiana.* — In 1927, a report from the Director of the Division of Wild Life, Louisiana Department of Conservation, stated in effect, that projects in the preceding twenty years for the draining of coastal marshes had been failures agriculturally; that these sections had gone back to their natural condition, and that they were better areas for fishing and producing food for waterfowl than they were before attempts were made to drain them.

*Maine.* — Great Goose Bog, near the town of Brownfield, Maine, was drained in 1906 by the owner for the purpose of growing hay. The project was not successful and the ditches were allowed to fill up. Several small ponds were included in the drainage area, but with the return of water, the bog is proving to be an excellent breeding and feeding ground for ducks as well as such fur-bearers as muskrats, mink, and raccoon. The owner is now deriving considerable revenue from the sale of hunting privileges and from the annual crop of fur.

*Michigan.* — More than twenty-six per cent, or an area in excess of 9,000,000 acres, of Michigan's total of 36,787,200 acres, is involved in drainage projects. These are located entirely in the Lower Peninsula, and those of chief interest from the viewpoint of wild-fowl conservation are in the region tributary to Saginaw Bay and Lake St. Clair, sections that were at



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one time among the famous ducking grounds of the Nation.

About 1912, Rush Lake in Huron County was drained upon petition of some farmers owning land in Lake Township. It seems to be somewhat of a mystery as to who was to be benefited, as according to reports the land surrounding this lake is practically worthless for farm purposes. In its natural state this lake supplied food and nesting sites for many ducks, while it was reputed to be a fisherman's paradise. The cost of drainage has been placed at \$11,500, but in 1924 a State representative, who investigated the area and interviewed farmers living in the vicinity, found them practically unanimous in a desire to have the lake restored to its former condition.

Writing in 1924 of the Saginaw Bay region, the veteran sportsman and conservationist, William B. Mereshon, said: 'A natural drainage of marsh lands is taking place. Tobico Marsh, for instance, lying on the west shore of Saginaw Bay about eight miles north of Bay City, was formerly a fine duck marsh with a heavy growth of wild rice. Continual lowering of the water of Saginaw Bay has gradually drained this marsh so it is fast becoming a bog hole. A good deal of talk is to the effect that this is being occasioned by the drainage of the Chicago Canal.'

A typical land scheme of the present day is found in the case of Sterling Marsh, covering about two thousand acres, and located in Monroe County, which was dredged and drained about 1925. The uncovered land was laid out in lake-front (Lake Erie) lots and held at five thousand dollars per lot. When examined in 1927 by a Federal Game Protector, the former marsh was



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found to be partly covered with a rank growth of grass and weeds, and with the exception of one club house, no buildings of any kind had been erected. This marsh was one of the best duck marshes in the entire State.

*Minnesota.* — Drainage operations in Minnesota were begun as early as 1880, and by 1920 it was reported that the amount of capital invested in these enterprises had surpassed the sum of \$200,000,000. With a total land area of more than 51,700,000 acres, the Bureau of the Census in 1920 found that 17.8 per cent, or a region in excess of 9,200,000 acres, was involved in operating drainage enterprises.

Some of these projects resulted in adding good agricultural land, but others were undertaken entirely at the instigation of individuals or companies who were looking only for their own immediate interests. It has been said that companies producing drainage machinery were active in promoting such enterprises, while the fees involved brought lawyers and even judges into the wrong side of the picture. Some of the laws passed made it an easy matter to establish a drainage district and saddle a heavy bond issue upon the community. As an example, it is reported that a judicial ditch system established in Beltrami County had five signers on the original petition, three of whom were non-residents of the county and the other two represented seventy-one and a fraction acres, yet the county was put to an expense of \$550,000. Furthermore, ditch taxes were considered first liens upon the so-called 'improved' property, even in cases where the land was miles away from the ditches and was in no way benefited by their existence. As a tangible result the Commissioner of Game and Fish reported in 1927 that

*Golden-eye*

*Harlequin*

*Buffle-head*

*Long-tailed Duck*









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three counties were bankrupt, 'due directly to taxation assessed for the construction of useless ditches.'

The damage being done was so apparent that in 1912, W. T. Cox, who was then State Forester, enlisted the aid of the State Forestry Association, the sportsmen's associations, and the Federation of Women's Clubs, and started a campaign to correct the drainage laws. These were gradually improved until a law was enacted to prevent future drainage operations without first obtaining the consent of the State Conservation Commissioner, who must now make a careful investigation of any area to be affected and render a report thereon. If his investigation discloses that the area sought to be drained is more valuable for public purposes in its natural state, the drainage project must be abandoned. The 1929 law provides the legal machinery whereby lakes and marshes entangled by judicial ditch proceedings, can be acquired by the State and their water-level changed to meet the conditions that will make them effective producers of wild life.

As we have previously noted, in addition to the direct injuries in this State resulting from drainage, fires having their origin in drained marshes have done an incredible amount of damage. With the destruction of cover by fire, the game birds and mammals have fallen easy prey to predators, while on numerous occasions primary destruction of game by fires has been exceptionally heavy. The resulting loss to wild-fowl through this wholesale drainage will be obvious, as in most cases the marshy lakes that afforded the best food and cover were the ones that received the attention of drainage promoters.

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The case of Thief and Mud Lakes, in Marshall County, is among the country's most glaring examples of unwise drainage. Thief Lake originally covered more than seven thousand acres, and Mud Lake about five thousand acres. They were considered the greatest breeding resorts for ducks and geese that have ever been known in Minnesota. Wild rice and wild celery were abundant, as well as other food-plants sought by Mallards, Canvas-backs, Redheads, Widgeons, and others. One observer reported that he recalled seeing Thief Lake covered with 'tens of thousands of wild geese, both Canadian Honkers and Wavies.' Prior to the prohibition of market hunting, carloads of waterfowl were shipped from these famous resorts. In addition to the birds, fish and furred game were abundant, the annual catch of muskrats constituting an important source of revenue to the farmers in the vicinity, while even moose and deer were frequently taken in the vicinity.

By means of State, judicial, and county ditch systems, which reached an aggregate cost of \$1,500,000, a region about twenty miles wide and thirty-five miles long was traversed with drainage ditches on nearly every section line, two main ditches passing directly through these two lakes. The water from the entire system drained into Thief River, a tributary of Red Lake River, which in turn flows into the Red River of the North, at East Grand Forks. In 1923, the lakes were entirely drained, the only water in their beds being contained in the traversing ditches. As an agricultural development project it was a complete failure.

Mud Lake is of peat-bog formation and of no value

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to agriculture. Thief Lake has a hard clay bottom, and while some of it has been successfully cultivated, the level of the entire region is so nearly uniform that Thief River will not carry off heavy rainfalls fast enough to keep the water out of the lake-bed at such periods. One report states that three thousand acres of this land placed under cultivation in 1919 were a total loss, as the heavy rains in July of that year flooded the lake and so ruined the crops. In 1920, the entire northern part of the lake was again drowned out and the crops raised on the southern part were of no value. It has even been stated that for several years the crops raised have not been sufficient to pay for the seed planted, and one settler claims to have lost twenty thousand dollars trying to farm the bottom of Thief Lake. In 1923, two assistants of the Biological Survey examined the area and reported that hardly more than a hundred ducks were breeding in small wet spots or along the drainage ditch. In that year only about three hundred to four hundred acres of the forty-nine hundred acres comprising the former lake bottom, were in cultivation, and the high taxes were obviously too much for the farmers to pay. The county budget was much in arrears with every indication that the funds invested in the enterprise would not be recovered. By 1929, two thirds of the drained area had reverted to the State for non-payment of taxes, and the Legislature was forced to come to the rescue to prevent three counties from going into bankruptcy. Through this act provision was made to take over as a game refuge some 1,500,000 acres by issuing State certificates of indebtedness and reimbursing the counties involved. The validity of the



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act has been twice attacked, but each time the State Supreme Court has rendered a decision sustaining the law. In all the State will pay \$3,250,000 for the acquisition of these lands.

Many other instances might be cited in this great State, which has been subjected to a most severe attack of the drainage fever. Millions of dollars have been expended, with the net result that few, if any, settlers have been brought in, while many have been burned out by the fires having origin in drained bogs and marshes. The waterfowl area in 1929 was estimated as being only about one third what it was ten years previously. Formerly one of the chief nurseries for wild-fowl in the United States, every one interested in these birds has a right to demand an accounting for the violation of a trust. The migratory ducks and geese belong to the people of the continent, and every Commonwealth so blessed by Nature as to have within her boundaries the breeding, feeding, and resting grounds that are necessary for their perpetuation has a sacred obligation to perform in safeguarding such regions from commercial exploitation.

*Missouri.* — The situation in Missouri is in many ways comparable to that in Arkansas, although a much smaller percentage of land is involved. Two thirds of the area in drainage enterprises is located in the southeastern corner of the State, being, in fact, a continuation of the Mississippi bottom-land drainage previously described under Arkansas. This has always been a wonderful region for migratory wild-fowl and must not be overlooked by conservationists.

In the southern half of the State are many smaller projects, some of which have been successes and others

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total failures. Illustrative of the latter class is Swan Lake in Chariton County. Originally this lake contained about one thousand acres of water and marsh land and was considered a fine resort for waterfowl. It was drained about 1917 and made into a cornfield, or at least attempts were made to grow corn on the old lake-bed. The result has been about one crop in five years, and four different men are reported to have 'gone broke' on the proposition. It is impossible to drain it so completely that accumulated rain and seepage water may not prevent either planting or harvesting. In years when the corn crop could not be gathered, the ducks have benefited, as the area then became a splendid feeding ground. In the spring of 1927, they were reported as present by 'millions' feeding on the corn that could not be harvested the preceding fall. There is considerable sentiment among local associations in favor of converting the lake into a refuge, for which purpose it seems to be naturally intended.

*Nevada.* — At least two areas in Nevada useful for waterfowl have been seriously impaired or ruined through drainage. The several miles of ponds and sloughs in the Washoe Valley were excellent breeding and feeding places for ducks. In the summer of 1925, a ditch was dug through lower Washoe Lake, by means of which the marsh lands were dried up and the water birds that formerly used them have been forced to go elsewhere.

*New Jersey.* — Drainage in New Jersey has been confined chiefly to the coastal marshes and has been carried on for two purposes — mosquito control and the development of shore lots for summer homes.

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The State Mosquito Extermination Commission has drained thousands of acres of salt marsh in its efforts to control these notorious pests. In 1927, through the efforts of Dr. William A. Steel, of Philadelphia, the Commission agreed to refrain from draining the deep salt ponds, the doctor's contention being that mosquitoes breed only in shallow waters, so that as a control measure the drainage of the deeper ponds is useless, while it would result in the destruction of important breeding and feeding grounds for waterfowl, principally Black Ducks. During the years immediately following the passage of the Migratory Bird Treaty Act, these birds showed a phenomenal increase in this region, but with the ditching and draining of more recent years, they have dwindled to a mere handful. The land reclaimed is, of course, practically worthless for agricultural purposes, and many persons living in the vicinity of these enterprises are much dissatisfied, but when high prices can be secured for building sites, it is evident that the work is likely to continue.

*New York.* — In the State of New York the outstanding example of drainage of marsh land with its effect upon wild waterfowl is the case of the Montezuma Marsh at the foot of Cayuga Lake. Originally this was the summer home of countless ducks, rails, gallinules, and other water birds. It was known by sportsmen as a wonderful hunting ground. According to reports about one hundred families living near by at one time realized about \$50,000 annually from the cutting of Cooper's flag or broad-leaved cat-tails, and in addition obtained large sums from the annual crop of fish, fur, and ducks.

When the State Barge Canal was put through in



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1911, drainage was begun, and was virtually completed a few years later. About twenty-five to thirty square miles of marsh were affected, and although it has been necessary to ditch the land to make it tillable, certain sections have produced good crops. In 1924, it was estimated that less than five percent of the drained area was under the plow, and one large tract that had been cultivated a few years before was then abandoned. The effect of the drainage also has been felt upon the surrounding country, as the flow of wells and springs has been reduced, and were it not for the dam at the foot of Cayuga Lake that beautiful body of water would be materially lowered. Even now the level of the lake is reported as being several feet below the average low-water mark.

It is interesting in this connection to draw attention to the Sink Hole Marsh located a few miles farther west, a large portion of which is owned by Mr. S. C. Vanderbilt. Through the protection of this marsh, its retention in a natural condition, and the trapping of muskrats along conservation principles, Mr. Vanderbilt has achieved a greater economic success than has been obtained by all the farmers about him. Also it produces excellent duck hunting in the fall, and to the naturalist is a source of never-ending delight.

*North Carolina.* — North Carolina contains one of the best examples of unwise drainage in the entire country. Mattamuskeet Lake in Hyde County, about five miles from Pamlico Sound, was originally one of the famous duck lakes of the Atlantic seaboard. It was about fifteen miles in length and five to six miles in width.

A drainage project was started in 1914, and it is



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reported that a sum well over \$7,000,000 has been expended by several companies in efforts to reclaim the lake bottom. As much of this is below sea-level, drainage by gravity flow was naturally a failure, and it was necessary to install a large pumping station having a capacity of 1,000,000 gallons per minute. With the pumps in operation it was possible to keep water from the lake-bed, but the cost was so great that the company in charge of the enterprise in 1924 finally went into the hands of receivers and the lake again filled. No effort was made to put any of the land exposed under cultivation, except one small section of about two hundred and fifty acres, which at one time was planted to corn and other vegetables. The seed germinated and the plants at first showed a healthy condition, but were then washed out by a heavy rain which flooded the area, and after the recession of the rain waters, the hot sun so dried and parched the ground that the crops were soon scorched and burned. In 1927, a United States Game Protector learned that the owner was making an effort to commercialize the lake for hunting purposes, but as the drainage activities had destroyed the natural duck food, the lake was chiefly valuable as a resting place. Under proper management it would seem that suitable food-plants might be restored and so return this fine body of water to the condition intended by Nature.

Another drainage project in the adjoining county of Beaufort, known as 'Terra Ceia,' caught fire in the summer of 1923 and burned for several weeks. Reports state that in places holes were burned in the ground to a depth of five feet, well illustrating its peaty composition.

*North Dakota.*—There are many drainage enterprises

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in North Dakota in the valley of the Red River, some of which have achieved the purpose for which they were conceived. The usual purpose has been to increase the capacity of natural channels which are inadequate to care for the rapid run-off from the rains and melting snows on their watersheds. As the existing channels cross a broad level plain, they usually meander, and in time of high water overflow and produce marsh or swampy land, natural breeding and feeding grounds for water birds.

An example of drainage that resulted in agricultural failure and much injury to waterfowl is found in the Mouse River Valley in Bottineau County. The area affected is about thirty miles in length, by three quarters of a mile in width, or approximately twenty thousand acres. The farmers holding the land conceived the idea that they would be greatly benefited if the channel were deepened and straightened, so bonds were sold and a steam dredge was put to work. As a result of the work, the water was drained off, but owing to the nature of the soil farming has not been made more profitable in any sense of the word. The original hay meadows were greatly damaged and the new ones formed were much smaller, while the cost of dredging and the increase in value for tax assessments brought such a heavy burden of expense that many farmers lost their land.

At least ten other projects of a similar nature in this county are reported as failures, with heavy losses to railroads, hotels, business men, and farmers, and with no gain to any one except the dredging companies. To-day, where ducks formerly bred in thousands, there are few or none at all.

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Another type of drainage is well illustrated by a study of conditions in North Dakota and, while seemingly unavoidable, it is none the less serious from the viewpoint of waterfowl conservation. Originally, with the prairie sod intact, evaporation of lake and marsh areas was limited almost entirely to their surfaces, the sun-baked soil of the surrounding territory effectively preventing excessive escape of the sub-surface moisture drawn from the natural reservoirs by capillary action. With the coming of the white man, this condition began to change. Vast areas were put under the plow and the hard surface was broken up and kept loose for the growing of crops. This immediately increased the evaporation, which continued to be drawn largely as a sub-surface supply from the near-by lakes and marshes. These, depending chiefly upon rainfall for the maintenance of their levels, were unable to stand the drain, and slowly but surely began to recede. As a result, many lakes and marshes are now entirely dry, or so reduced in size as to convey only a suggestion of their former condition.

Devil's Lake, which at one time was about thirty miles in length, is now little more than a series of three or four small, shallow, alkaline lakes, more or less connected by channels. The area of these is steadily decreasing. At one time a small steamer that plied on the lake docked practically at the city of Devil's Lake, but the lake has so receded that the present shore-line is a full mile away. A project for refilling this lake has gained some momentum in the State, and if carried out it would seem possible to transform it gradually into a valuable body of fresh water.

*Ohio.* — Drainage in Ohio that is of importance in



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its relation to migratory wild-fowl has been confined to the lake shore. The marshes adjacent to Sandusky and Toledo have been valuable ducking areas, as they support large quantities of important food-plants.

The gradual but progressive lowering of the lake level has caused many of these marshes to dry up. In 1924, a Biological Survey official, who for fifteen years had been in close contact with the conditions, reported that, unless drastic measures were taken to preserve the Lake Erie marshes, they would in ten years be a thing of the past. The general opinion as to the cause of the lower lake level is that the Chicago Drainage Canal is chiefly responsible, and when one considers the millions of gallons of water that daily pour through this artificial waterway it would seem that popular belief is very close to the correct explanation.

In addition, some of these marshes have been drained for agricultural and real estate development. With some areas, the constant operation of pumps has been necessary, so it is interesting to know that some duck clubs have bought up certain tracts and reversed the pumps. One of these, a small club at Oak Harbor, bought fifty-six acres of drained farm land, reversed the pumps, and soon produced an excellent duck marsh.

*Oregon.* — From the viewpoint of waterfowl areas, Oregon is naturally divisible into two major regions separated by the Cascade Range. In the western sections, where the ducking areas are not only in coastal sounds, bays, and inlets, but also comprise marginal marsh, as along the Columbia River, some reclamation has taken place, with resultant decrease in the habitat for ducks and other water birds. Much of such work is, of course, unavoidable, but it should be



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borne in mind when considering the future of waterfowl and in planning measures for their relief.

In the eastern part of the State, the adverse conditions affecting Upper Klamath Lake are not only serious, but in many ways unique. Through control of the water-supply by irrigation and power interests, this lake has been converted into a storage reservoir. This results in great fluctuation of the water-level, which is high in spring, but by midsummer has been greatly lowered. In consequence, the adjacent marshes are attractive to ducks and other water birds at the beginning of the nesting season when water is abundant, but by the time the eggs have hatched and before the young birds have developed sufficiently to enable them to move to other sections, and while many of the adults are still in the moult and consequently are helpless, the marshes are likely to be entirely dry. They may thus become a veritable death trap, which is well illustrated in the report of a United States Game Protector, who in August, 1928, found several young ducks, unable to fly, wandering about in the pine timber, many miles from any water. Most of such birds undoubtedly die of starvation or fall easy prey to predatory animals.

The excessive droughts which sometimes occur in the West have been responsible for many of the lakes and marshes in the Warner and Harney Basins either drying up or having their levels so reduced that their usefulness as wild-fowl areas ceased. In 1925, it was estimated that during the preceding two years the acreage of marsh land in the Warner Valley had decreased at least fifty per cent. In that year, a Biological Survey representative tendered a report on the

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region, which included his own personal knowledge of the situation, extending over fifteen years, combined with information obtained from officials of the Forest Service and the Geological Survey. As a means of illustrating what may happen from such natural causes, the following summary of this report is of interest:

‘In the Warner Lake Valley, during the past two years, owing to drought the flow of streams entering the valley has greatly decreased, with the result that during the past summer... Flagstaff and Blue Joint Lakes, together with the adjacent small unnamed lakes and ponds, entirely dried up, there being no water whatsoever in this valley north of a short distance beyond Plush. The waters in Crump and Anderson Lakes receded materially, but being deeper lakes have not uncovered as large an area of ground as the shallow lakes to the northward.... Goose Lake in Goose Lake Valley, tributary to Lakeview, has been reduced to at least one half of its former size during the past three years. I estimate the same reduction occurred at Abert and Summer Lakes. Alkali Lake, just south of Wagontire Mountain, in southern Harney County, has practically dried up during the past three years. During the latter part of the summer of 1925, there was no water whatsoever in the bed of the lake, the only water in that section being in the well-known Alkali Spring, which did not overflow its banks.

‘Silver Lake, during my first visit there in 1912, covered an area of approximately fifteen miles by eight miles. It gradually receded and went entirely dry during the summers of 1918-19. No water whatsoever has been in the bed of this lake since then. Benjamin

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Lake, a shallow alkaline body of water just west of Wagontire Mountain, in Harney County, has been absolutely dry the past two summers. In the Warner Mountain section, Guano Lake has practically dried up since 1917, the only water there being an overflow from Guano Creek, which has not had more than one half of its normal flow the past two or three years. The small, shallow lakes just east of Warner Mountain, known as Spanish Lake and Desert Lake, have had no water in them whatsoever the past two years. During the years prior to 1920, a considerable crop of hay was harvested on the bed of Spanish Lake. During the past three summers, no hay whatsoever has grown on this lake-bed. The spring at Desert Lake has been extremely low, not furnishing sufficient water for the band of antelope and half-wild horses in that section the past two summers. During the summer of 1924, Indian Springs, on the northeast slope of Warner Mountain, one of the principal watering-holes for antelope, entirely dried up. During November, 1925, I visited this spring and found it still absolutely dry. The bed of Christmas Lake has been dry for a number of years and the spring that formerly fed this lake was nearly dry during the fall of 1924. In the Malheur Lake region, although I have no accurate figures, I visited this section each year for the past several years and the general water-supply in the entire area has been steadily decreasing. During 1914, the Geological Survey estimated there was a flow from Silver Creek into Silver Lake [Harney Lake], Harney County, sufficient to irrigate 30,000 acres of land. For the past three years there has not been sufficient water flowing into Harney lake-bed to wet the ground for more



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than a hundred feet from the sand dike where the channel enters said lake-bed. The swampy area adjacent to Malheur Lake has been gradually drying up, and the only water of any consequence coming into Malheur Lake this present year has been a fairly reasonable flow from the Blitzen River on the south. Last year [1924] Silvies River, north of Burns, practically dried up. During August of that year, I was along the course of this river in Silvies Valley north of Burns and found nothing but pools of stagnant water in the river-bed. The extremely low water that year resulted in an enormous destruction of fish. Swan Lake, adjacent to Malheur Lake; Backa Lake, adjacent to the Blitzen River, a few miles south of Malheur Lake, have both been entirely dry. Backa Lake formerly covered several hundred acres and was bordered with a dense growth of tules which furnished breeding and feeding grounds for a large number of ducks and geese as well as other waterfowl.'

Malheur Lake, above mentioned, is a Federal Bird Reservation, and at one time it was a large and important breeding and feeding ground for waterfowl. Now, however, its two chief sources of supply, Blitzen River at the south, and Silvies River at the north, are so taken up for irrigating purposes, that the lake is gradually receding. During years of heavy rainfall, there may be sufficient water to flow from the main lake to Mud and Harney Lakes, but neither of these has any importance as waterfowl areas. Plans are being contemplated for a series of short dikes between natural islands in Malheur Lake, which, if constructed, would seem to assure the preservation of at least a part of this important area.



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*Washington.* — In this State the waterfowl areas that have been ruined by drainage lie almost entirely east of the Cascade Range, being located chiefly in Spokane, Yakima, and Benton Counties. The Columbia River follows a general north-and-south line across this region, providing a natural flyway for the migratory birds, while the many lakes and marshes in the contiguous territory supplied food and resting grounds.

There is no question but that some of the drained areas have produced fine agricultural land. For example, Crab Lake in Grant County, with an area in excess of 1300 acres, was drained twenty-five or thirty years ago and is now reported as some of the richest farm land in the county, with an assessed valuation of \$70 per acre. On the other hand, the agricultural value of some drained lakes and sloughs, chiefly in Spokane County, may be listed as doubtful.

In addition to direct drainage several waterfowl lakes have been injured through evaporation and the drawing-off of water for irrigation. Such is the case at Silver and Clear Lakes. It is reported, however, that pumping at Silver Lake has been abandoned and that the water-level is showing a tendency to return to normal. Clear Lake furnishes irrigating water for the State Hospitals at Medical Lake and probably will continue to serve this purpose.

*Wisconsin.* — Although in 1920 only a little more than two per cent of Wisconsin's 35,000,000 acres were involved in drainage projects, these include a few glaring examples of unwise enterprises, which have been total losses agriculturally, and have, moreover, robbed the citizens of a part of their heritage of healthful recreation at wild-fowl resorts. According to Dean

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H. L. Russell, of the University of Wisconsin, an area of marsh land, covering between seven and eight thousand square miles with intervening sand islands, lies beyond (south) of the great terminal moraine, and it is here that the majority of the drainage work has been done. Writing in 1928, Dr. Russell states that 'these districts have been highly improved so far as removable water is concerned and from time to time there have been as many as 1000 farmers in the region, but these are now reduced to not more than 115, and practically all of the districts have gone into bankruptcy so far as tax delinquencies are concerned and the land is going back to the State or counties.' This statement is most significant.

A much-discussed area is the famous Horicon Marsh in Dodge County. This has been estimated to contain about forty thousand acres, and was at one time reputed to be the largest artificial lake in the world, made by the dam at the town of Horicon. Following a controversy regarding land-ownership in 1868, this dam was torn down, producing a great marsh that extended on both sides of Rock River to a point thirteen miles north of Horicon. It was considered one of the best breeding places in the northern part of the United States for ducks, fish, and fur-bearers, the annual fur production going as high as 50,000 muskrats, 6000 to 10,000 mink, and 2000 raccoon.

Two attempts have been made to drain the marsh, neither being successful, for while some of the drained land will produce crops as good as the surrounding country, they are no better, and a vast area is still too wet for agriculture, but is too dry for waterfowl. There is so little fall in Rock River that water is very

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slow in draining off the marsh, and spring rains will at times melt the winter snow so rapidly that four or five feet of water may cover the marsh in twenty-four hours' time. With the slow run-off, farmers are unable to plant crops in time to take advantage of the short season for growth. Also the marsh land is chiefly peat, in places twelve to fifteen feet in depth overlaid on black clay that is almost impervious to water. After a lengthy legislative battle, waged chiefly by the Izaak Walton League, the State Legislature, in 1927, declared Horicon Marsh a wild-life refuge and designated a dam or dams to be constructed to raise and maintain the water-levels that existed prior to drainage. Constitutional and legal interpretations were immediately raised, apparently by drainage interests, and the case finally went to the State Supreme Court, which wrote the final chapter in the fight, upholding the constitutionality of the act. Restoration must now be accomplished before the present desolate waste can be returned to its original place as a breeding and feeding ground for winged, furred, and finned wild life.

Another great marsh area in this State that has been the scene of unsuccessful drainage operations is the Buena Vista Marsh in Portage County. This is located in what has been called the Plainfield Sand District, a region that does not produce good pasture, so the wild hay originally grown in the marsh was an important item to near-by farmers. An estimate in 1923 gave the sum expended on draining and improving the land as in excess of a million dollars, and while some of the farmers seemed satisfied, others were unable to make it pay and left after suffering



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heavy losses. Some farmers considered the value of the land as only about half what it was before it was drained, as the cost of upkeep for agricultural production was too great. Literally carloads of grain have been sowed, but never harvested, as it would fall down and spoil before it was ripe for cutting. The peat is of a character that will burn readily in a stove, and bad fires in the dry marsh have been frequent. In one year it was estimated that fires there cost the State five thousand dollars. Much of this marsh land is now reverting to its former wild state. Still another area, known as the Trempealeau Bottoms, on the Wisconsin side of the Mississippi River, near the town of Trempealeau, was drained several years ago for the purpose of controlling mosquitoes. As a result, an area estimated as nine thousand acres of worthless land was uncovered, but, curiously enough, we learn that the water has now (1929) been restored in furtherance of a fish cultural project.

*Canada.* — For information relative to the drainage of lakes and marsh land in Canada we are indebted to the Honorable J. B. Harkin, Commissioner, and Mr. Hoyes Lloyd, Supervisor of Wild-Life Protection, National Parks of Canada, who in our behalf communicated on this subject with game and other officials in the different Provinces.

The importance of the waterfowl breeding areas of Canada cannot be overestimated, and it is accordingly gratifying to learn that the total area of Dominion land drained in Alberta and Saskatchewan is (1929) only approximately 55,000 acres. At least ninety-five per cent of the schemes carried out have comprised small projects ranging from a few acres to about a



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hundred acres, which were undertaken by resident settlers who were desirous of reclaiming low lands in or adjoining their homesteads, for the purpose of increasing the production of forage crops. None of the schemes carried out under Federal control is considered to have been deleterious with respect to wild-fowl. So far as the Dominion Water Power and Reclamation Service can determine, the accomplished drainage has not had any effect upon the water table of the surrounding district.

In Alberta there is one case, that of Big Hay Lake, situated about forty miles southeast of Edmonton, which during some seasons was an excellent breeding ground for waterfowl. This lake was partially drained, but the area of tillable land has not been increased, due to the fact that the old bed of the lake is of such a nature that the farmers have not been successful in cultivating it properly. According to Mr. Benjamin Lawton, Game Commissioner of Alberta, it has been demonstrated that the cost of draining such areas is often so excessive that those who may be benefited find it a considerable burden to meet the payments for the reclamation of the lands.

The drainage of Sumas Lake in British Columbia has unquestionably spoiled an excellent resting place for migratory birds and has been responsible for the loss of much duck shooting in that district. Another drained area in this province is the False Creek area, which provided good duck shooting when in a state of nature.

Drainage operations in the other Canadian Provinces have either not been attempted or have been inconsequential with respect to wild life. Colonization

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plans in Canada are going forward, however, and with the increase in human population, drainage proposals are sure to become more numerous. It is accordingly hoped that the conservation officials of our northern sister will be ever alert and constantly on guard to preserve the areas required by our migratory waterfowl for breeding and feeding purposes. Mr. Hoyes Lloyd has already shown how the regions suitable for human occupation include important breeding grounds for some species, such as the Redhead, so that it will be obvious that many areas must be protected against the encroachment of civilization. Canada already has done much along these lines, but all sportsmen and conservationists join in the hope that her wild-life reservations will be still more increased and that iron-clad laws will protect them against any so-called 'development.'

*Mexico.* — As we have previously indicated, some important wintering areas are located in Mexico. Full details illustrative of the extent to which these regions have been despoiled by drainage activities are not available, but we do know that two of the major areas have been seriously affected.

The largest body of water in the country was Lake Chapala in eastern Jalisco. This lake, while not continuously bordered with marsh, did support extensive marshy areas and was an important concentration point for waterfowl. The principal tributary is the Rio Lerma, which enters the lake in the northeastern part. A bare ten miles west of this inlet the Rio Santiago leaves the lake, flowing northwest to reach the Pacific a short distance north of San Blas. According to Major E. A. Goldman a series of dikes has been

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built, cutting off the principal marshes which were in the delta at the east end, so that now the waters of the Rio Lerma, instead of spreading out into a shallow marsh, are carried directly into the deeper part of the lake. The lake-bed area so recovered is reported as rich agricultural land, but is of much less value than the former marsh.

In the Valley of Mexico, the results have been somewhat different. From earliest historic times this region was noted for its great swamps and lakes, Cortez in his conquest of the country finding these to be formidable obstacles to his occupation of the Aztec capital. Naturally they were valuable as wintering grounds for large numbers of migratory waterfowl as well as affording breeding areas for those species that are native to the region. Much of the marsh territory has been drained, primarily to remove a constant menace to the City of Mexico from invading lake waters. It also was believed that much tillable land would be recovered, but the information at hand indicates that the reclaimed land has very little value for the growing of crops.

In concluding this chapter it seems fitting to reproduce the verses of Mr. O. F. Immel, 'The Voice of Trempealeau Marsh,' used by the Trempealeau Bay and Upper Marsh Restoration Club, of La Crosse, Wisconsin, in its efforts to effect the return of this valuable wild-life region to its original condition.

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## THE VOICE OF TREMPEALEAU MARSH

Barren lake beds, waste and ruin,  
Monuments that mark my fate;  
Living things, Fin, Fur, and Feather  
Driven out beyond my gate.  
Lilies, Lotus, Mammoth rice-fields,  
Homes and food for wild life gone,  
All destroyed by worthless dredging,  
There's no place left where fish can spawn.

Lakes, Puldoo and Wilson, linger,  
They to drainage would not bow,  
Pony Crossing, too, defiant,  
Miring deep the tractor plow.  
Live stock perish in the ditches,  
Treacherous quick-sand, victims claim;  
The drainage project, proved a failure,  
Ruined a paradise for game.

O'er the rustle of the rushes,  
On the winds that whistle through,  
An S-O-S call, I'm sending,  
To broadcast my fate to you.  
I'm a — devastated — area,  
Shorn of value by the dredge;  
Give Trempealeau River back to me,  
A wild-life refuge I will pledge.





## CHAPTER II

### SHOOTING AS AN ADVERSE FACTOR

ONE of the most difficult tasks which confront the investigator is a proper estimate of the actual damage to wild-fowl inflicted by the gun, and its relative importance when compared to other adverse factors.

On a grouse moor in Scotland or a pheasant preserve in England a skillful keeper can form a very close estimate of the stock which he has on hand at the opening of the season and the stock left at the end of the season. He knows exactly what numbers are shot and just about what to allow for other factors like disease and vermin. His problem is comparatively simple.

On a well-managed quail preserve in our own South, one can tell over a period of years about how many coveys there are, whether they average large or small, and how many birds can be taken without interfering with the breeding stock. The individual bird seldom travels over a mile or two, and the group or covey is

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still more closely confined to a certain feeding range, at least during the autumn and winter.

But when we come to estimate the percentage of kill to total numbers available of any particular group of wild-fowl, for example, the Mallards that migrate through the Illinois River Valley, we are confronted by a problem of real complexity.

Until banding of wild-fowl on a large scale was begun, we had no idea of the ratio between ducks available and ducks shot in any one season. We are beginning to see a little light on this problem, and in a few more years we will have something very definite to talk about. On this point more will be said later.

One of us has already pointed out that, if we had fairly accurate figures for the number of game wild-fowl killed in North America in any one season, a reasonably accurate estimate of the total number present for that season might be obtained by a percentage computation based on the proportion of the banded birds that are killed. We know that proportion to-day and can predict it with fair accuracy for different regions, thanks to the increasing coöperation of sportsmen and bird-lovers with the United States Biological Survey.

The time has come when sportsmen should ask their State Legislatures to authorize the game commissioners of their several States to demand a return of game killed from each individual license-holder. We ought to take account of stock, and this is another way of making a start in the right direction. Already a number of States have collected figures of really considerable interest, namely, Massachusetts, Minnesota, Maryland, North Carolina, California, Pennsylvania, and Virginia.

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There is another valuable set of figures which are even now available, but which for one reason or another are largely kept in the dark. We refer to the annual bags of the legitimate clubs organized for purposes of recreation and not for commercial ends. The Biological Survey, in coöperation with the American Wild-Fowlers, has assembled a considerable number of these club records and analyzed them as to species taken, daily bag of birds per gun per day, etc. A number of interesting points have been brought out by this investigation and will be referred to later in this chapter. It would seem to us only fair that, in view of the privilege which these clubs now enjoy, they should be registered with the Department of Conservation in whatever State they happen to be situated. In this way some idea could be obtained of the amount of property being held for ducking preserves, whether it is held for recreation or for the profits derived from the growing commercialization of sport. In time we should have available a splendid set of figures showing the relative kill of important game wild-fowl by species, the changes that take place from year to year, and the still more important changes that appear progressive over a long period of years. The cause of conservation would be materially advanced if it were made obligatory that all clubs shooting migratory birds should be registered in some central bureau like the Bureau of Biological Survey.

The general trend of conditions as to utilization of ducking grounds is well known. The club idea, most highly developed in California, is spreading all over the country. Attempts have been made to check it by legislation in some States, particularly in North

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Dakota, but it is not likely that radical laws which interfere with the rights of land owners in enjoying the privileges of their own properties can ever make much headway. These attempts seem to us merely an indication of the discontent which most certainly follows when the public first begins to realize that the pioneer opportunities for free shooting are coming to an end. For the end is inevitable as a natural consequence of the development of the country and the imposition of all sorts of checks on the freedom of the individual; the price the average American has to pay for the increase in conveniences, luxuries, and speed of travel.

Some such loss of opportunity for sport for the average American would come about inevitably through the development of our country, entirely aside from the amount of game available. But this trend is enormously hastened by a decrease of game and an increase of guns which has gone on hand in hand for many years. Thirty or forty years ago the slogan 'Stop the Sale of Game' was regarded as a cure-all. Sportsmen looked forward with confidence to extraordinary benefits following the termination of commercialism in game. But when we finally got our markets closed between the years 1900 and 1913, shooting as a sport had increased so much in popularity that there was no more game available for the average shooter than there was during the days of market shooting. Actually there was not so much. Fully as important also as a contributing factor was the diminution of water areas which we have referred to in the preceding chapter.

Now let us look at the problem from the angle of



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plain arithmetic. We are convinced that about 8,000,000 to 9,000,000 ducks and geese are shot in the United States in a year. The figure has been placed as high as 12,000,000, or 14,000,000, but we prefer to be conservative. If we make a guess that there are at least one million potential duck shooters out of our seven million-odd shooters, then there are to-day available for each one of them only eight or ten ducks per year. And this number is so small that if opportunities were really equalized, which of course is impossible, no one man could shoot enough wild-fowl to make it worth while to own a gun or a pair of rubber boots, to say nothing of the rest of his equipment, and his State license.

Before we consider the actual figures which we already possess, let us glance at the individual shooter of to-day, be he a club member or only a sporadic performer who depends upon the knowledge of others to tell him where to go and what to do when he gets there.

In the older days which we read about, or remember with something of regret, a ducking trip was a real adventure. It required a long time in the planning, a good deal of initiative, a certain amount of willingness to endure hardships, rough fare, and very early hours. But much more important than all these things a ducking trip meant time and leisure, and both of those commodities were scarce in our grandfathers' days. Those old sportsmen, too, had to take things pretty much as they found them, and they had either to shift for themselves or put themselves into the hands of a hired market shooter and gun in direct competition with other native market shooters. This at least was

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true in the older settled regions and we are not talking about the frontier of the West.

But now transfer your attention to the modern duck shooters. Overnight they spring to action fully armed and clothed, not like brother Bryan's mythical million-man-army, but creatures of flesh and blood, hundreds of thousands strong, with their rubber boots, sport clothing, and magazine guns.

Suppose our would-be duck shooter decides overnight to go on a foray. A friend may suggest to him some place to go to, or he reads an 'ad' in a sporting paper, or maybe a gun store gives him the contagious sporting 'itch.' Straightway he gathers an outfit proper to the occasion; it makes no difference whether he knows a Mud-hen from a Mallard, for kindly(?) hands will steer him over the rough places. And so by train, motor car, and motor boat our newly clothed sportsman is whisked in a few hours to the firing line. There he is placed in a blind, which mayhap has just been vacated by another party, and there he is carefully coached to hold his fire until the deadliest moment arrives and then to empty his magazine gun in the general direction of the game. If he cannot get his limit in the allotted interval of time, somebody else will accommodate him. Be the luck good or bad, he goes home triumphant with a string of birds. He has had a taste of high-pressure duck shooting, he has shot away a lot of ammunition (for which the manufacturers are deeply grateful), and he has inadvertently left a good many stray pellets in the rear ends of various ducks that he never even aimed at.

Now it is a good thing and a lucky thing that the average unorganized sportsman can still find a place

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to go where there is a chance to shoot a few ducks. His opportunities are sure to grow less. But this book is concerned with ducks first and sportsmen afterwards. The point is that the exploitation of public ducking grounds is becoming more pronounced. There are just about so many shooting stands available on just so many ducking areas, to accommodate a growing shooting public, and the temptation to make as much as possible out of such places is natural. If conditions are right, several limits can be shot out of one blind or battery in one day. With the liberal use of bait and a reduction of shooting days or shooting hours, enormous kills can be made on one small property. We have heard of one stand where 300 or 400 ducks were legally shot by a number of men in one day.

Public shooting grounds can never, we believe, solve the predicament of the unorganized shooter. Unless the public area is somewhat remote or difficult to get at, the shooting develops into a second Fourth of July and is all over in a few days. It is true that in some not too closely settled regions a certain amount of strictly limited shooting may be made available to the public one or two days a week, but we know that it is a matter of expense to provide shooting of almost any kind, and there is no very good reason why the State should be asked to do any such thing. It would certainly cost a great deal more than free golf or free tennis. No, the natural public shooting grounds are, and always have been, the coastal marshes and flats and some parts of the larger lakes.

The State, of course, can create sanctuaries and care for them at little expense as an object lesson in practical conservation, but it can never indulge in the

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luxury of maintaining permanent free shooting on a large scale. The sanctuary, especially a wild-fowl sanctuary, is interesting to nearly all classes of the population; therefore it can be created and maintained by public money. Free duck shooting would mean a tax on the average sportsman that he would be quite unable and unwilling to bear. And as we have shown elsewhere the supply of ducks would simply not be able to stand the additional strain.

Now look at our problem from the point of view of the migratory game itself. Suppose we have the present Federal limit of fifteen ducks per day, what difference does it make to the ducks and geese whether it is lowered or not? Merely this, that always provided a low bag limit is enforceable, more men will participate in the shooting of very much the same number of ducks. More men will be accommodated by shooting resorts and more men will always be available as our shooting public grows in relative wealth, in leisure, and in touch with rapid methods of travel. Think of the field opened up to sport by air travel, scarcely comprehended to-day! We know of one island off the coast of New England which could not be reached even under good weather conditions in less than thirty hours, and often could not be reached at all. One can land there now in forty minutes from the airport of a large city!

The club system is, as far as we can see, here to stay. Without it our wild-fowl would to-day be in far more desperate straits than they actually are. Entirely aside from the ethics involved, the big acreage ducking club with a small membership is doing more to preserve wild-fowl than any other single factor. If all these preserved areas were opened to the public to-



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morrow, the benefit which that public would actually experience would be of a very temporary character, while the damage to the wild-fowl would be permanent.

Therefore, any reduction in the shooting privileges of the individual must ultimately take account of the fact that some individuals, through land-ownership, are doing more for wild-fowl, for the preservation of their feeding and resting grounds, than are others. Radical reduction in shooting privileges can do actual harm to our stock of wild-fowl by discouraging the maintenance of protected feeding and breeding areas now owned by clubs and individuals.

We will not attempt to suggest just what adjustments might be made in order to strike a balance between the very diverse human interests, always having in mind, of course, the permanent welfare of the birds themselves. A State tax might be levied on club members, the funds from which could be devoted to the maintenance of sanctuary areas or increased warden service. Clubs in the Northern States could breed large numbers of Mallards, which might be added to the numbers of migratory wild-fowl allowed under the law. It might even be possible at some future time to have a State or Federal commissioner designate the numbers of wild-fowl which ought to be shot on each property. Any such figure would depend on the size of the marsh or lake and the relative numbers of wild-fowl which visit it in season.

Let us look at the club situation and notice some of the recent trends which are rapidly changing the character of the average duck club. The club idea did not take root until the middle of the nineteenth century and at first only on the Atlantic Coast. The

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first clubs opened up in the Chesapeake region near Baltimore about 1836. Not until after the Civil War, however, did ducking clubs become common or popular and spread far and wide. The earliest clubs in the lower Mississippi Valley were opened about 1880, and the California club system of shooting gained no headway until about 1900.

The older Eastern clubs were resorts of leisure and plenty, and members often stayed for several weeks or a month. A few 'gunned' through most of the season with a trip home around Christmas-time. Nobody thought about being criticized for making large scores, and the members took things rather quietly, went to bed early, and if the weather was too rough often did not go out at all. In short, they made the club a real home. All this is changing fast. Due partly to the more general adoption of the strenuous concept of life, and partly through the various restrictions on shooting, some Federal-made, some State-made, and some club-made, the average club shooter now stays a few days only; or perhaps he will break up his season into several short trips. Easy transportation has brought the shooting club almost next door to the city home, so that a business man can sometimes shoot his limit and be back in his office by ten o'clock in the morning!

Various State or county laws, or tacit understandings of one sort or another, have in many places reduced the number of shooting days; at first to four a week as in Currituck County, North Carolina, and lately to two a week in most of the Chesapeake Bay clubs and in California and Arkansas. And the reasons underlying this trend are not altruistic, they are in-

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tensely practical, and are intended to give the fowl an opportunity to rest, to become tamer, and to take kindly to the bait provided. In other words, to reduce uncertainty in fowling to its lowest terms. But what a difference in the club life of the present-day shooter! How much has been sacrificed! High-pressure methods, inelastic club rules, and expensive comforts have replaced the simple régime of only a few years ago. An air of bustle and forced enjoyment pervades the house, the long-distance telephone connects the sportsman with Chicago and New York, and the shooting club is little removed from the golf or country club where one rushes off to accomplish a certain number of holes before the dinner hour.

But what of the ducks? Here, again, as the shooting becomes more artificial, as limits are lowered, and as rest days become more and more common, because more necessary, there may be opportunities for a larger membership in some of these clubs. No fewer ducks will be shot, but more men will shoot them, and less time will be occupied in the taking of each individual duck or each 'limit.' The wild-fowl in fancied security can in many places be handled and brought to the gun almost as surely as Scotch grouse are driven over the butts.

We have expanded this part of our subject in some detail to show that, no matter how many or how wearisome the restrictions imposed by law on the individual sportsman, the potential opportunity for making a large annual Nation-wide bag will remain about the same as it always did. It was very interesting to find, when first the Federal limit of twenty-five ducks went into effect, that in some of the Currituck



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clubs the annual club bag or even the average daily bag actually tended to increase rather than diminish. This unexpected result was brought about simply because shooting opportunities were more evenly divided among the members and among the shooting days; the ducks fared just as well, or just as badly, as before. There were about so many ducks visiting each property and that same number was still available to the members of that particular club, whether the limit was twenty-five or fifty ducks a day, or for that matter ten ducks or fifteen.

Speaking very generally — and we are perfectly well aware that there are plenty of exceptions — the legitimate duck club that owns or leases its own property and pays a considerable land tax is usually interested in the perpetuation of its own shooting. A falling-off in seasonal bags or in daily bags will be followed by an optional reduction in the privileges of the club members. Rest days will be set aside, or certain parts of the club waters will be reserved as an inviolate sanctuary. Possibly the members will be required to pull up their decoys by a certain hour of the day so that the property may be left undisturbed during the whole or part of the afternoon.

So that, again speaking generally, the better-class club can be trusted in the long run so to regulate its shooting that there will be no permanent or progressive falling-off in the number of wild-fowl living on its properties. Or, more accurately stated, such a club will do the best it can to maintain its available stock of ducks in the face of the possible falling-off of the flights in that particular neighborhood.

Here is another change which ought to be noted.



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The public or open shooting ground tends to become commercialized more and more, so that the sportsman who has no place to go can at a price get a considerable amount of more or less indifferent shooting. This commercialization, however, tends to go hand in hand with the illegal traffic in game and in out-of-the-way places with moonshine distilleries and rum-running. We have watched with some alarm the steady growth of game bootlegging, which in certain regions has become so firmly established that it will be difficult to uproot. Wild-fowl are the victims of this practice perhaps more commonly than other kinds of game.

The Federal game protectors are too few and too scattered to cope with the present situation and far larger sums are needed for enforcement of the Migratory Bird Treaty regulations. The Nation-wide conditions which have developed as a result of the Volstead Act have undoubtedly had a very unforeseen and very unfortunate effect on the conservation of game. Underground channels for any sort of illegal traffic are now readily available, and a tendency to disregard all law is disastrous to the maintenance of our game codes, where a voluntary spirit of sportsmanship and fair play is our main reliance.

So much for general conditions. Let us see whether we can get any clear picture of the risks which the individual waterfowl runs during its journey South, and on its wintering ground. Suppose we take a pair of Mallards rearing a brood in southern Saskatchewan. The female will lay nine or ten eggs, if all goes well, of which she will hatch nearly all. If an accident happens to her nest early in the season, she will take the same

*Mallard*

*Spoonbill*

*Black Duck*

*Pintail*

*Gadwall*

*American Widgeon*









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or another mate and start another family. We need not dwell here on the many risks which she has to run during the breeding season. But the various risks to the family are multiplied after the young hatch, and if the brood is destroyed in late June or in July, it is usually impossible for the mother bird to repair the damage. Although we do not know exactly what the average brood of Mallards numbers at the end of August, we can give a fairly intelligent guess, allowing, of course, for all such factors as bad hatches, losses from predatory mammals, birds, fish, and turtles, as well as for those females which for various reasons do not build nests at all. We may, therefore, place the average number of young Mallards per pair of adults which are actually matured and ready to migrate in early fall as between four and five. Therefore, if the population of ducks which leaves our borders in spring returns to us doubled in size, that is all we can possibly hope for in a good year. Remember that there are bad breeding seasons, or more properly cycles of good and bad breeding years, the reasons for which we do not understand at all. Some of them are correlated with cycles of rainfall shortage and abundance.

And in making any estimate of wild-fowl in the future full consideration should be given as to whether any particular year is or is not an 'off' year. Off years have always occurred and always will occur, so that we should not get hysterical, but merely seek the cause, and if necessary check shooting temporarily.

We must also not forget that with many species of ducks, especially the diving and marine ducks, the females do not all become sexually mature during their first year.

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If we turn to the geese and swans, we find a very much slower rate of increase. Not only do the geese lay fewer eggs, but they reach sexual maturity only after two or three years, so that their net increase is not more than half so much as that of the ducks. No doubt the longer life of the individual, and on the whole their much greater intelligence, makes up in part at least for the small number of young hatched. For example, the mortality of young Canada Geese after they hatch is certainly much less than that of the common shoal-water ducks. But, allowing for all these things, it is not likely that on the average more than three young geese and two swans are placed on the wing in August or September for every two potential parents.

The natural losses of the adults are difficult to estimate, but we know something of the age limits, and it seems certain that few shoal-water ducks live to be more than ten or twelve years of age, so that the average length of life (aside from accidents) is only about seven years at best, and it may be considerably less. We must, therefore, write off an annual loss of at least fourteen per cent, due to the natural wear and tear operating on the adult stock. This would certainly be far less among the geese, where the average age attained is much greater, certainly twenty-five years in the Canada Goose, and under exceptional conditions double that figure. Swans, too, live to be very old, at least in captivity.

We have attempted a rough estimate of the perils surrounding the duck population. But these perils are in operation twelve months of the year, so that the natural mortality of the adult stock, through disease, old age, and wild enemies, must be at least twenty per

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cent and no doubt in some groups as high as thirty per cent.

It remains for us to consider actual figures to show as nearly as possible the annual mortality from the gun among different groups of ducks banded at various places in the United States and Canada. We know the total number of each species banded at these various points, and we know the number of returns which come back to the United States Biological Survey from bands recovered on shot birds each year. In this way we get a very accurate picture of what we shall call the artificial mortality of wild-fowl; those that are destroyed by the gun alone.

The mortality of banded wild-fowl varies with the time of year during which the birds are marked and the density of the concentration of shooting in the surrounding territory. For instance, suppose a group of ducks is banded near Browning, Illinois, at the height of the shooting season, we will get a very large return of ducks before the season closes. On the other hand, if we band a group of ducks at the same point in the spring on their way North we get only about the average per cent of returns during the following autumn and winter. In calculating percentages we use for purposes of comparison the return total for each station or group based on the returns obtained during the first shooting season succeeding the date of banding. For example, in the case of a station operating in the autumn the returns would be counted up to the end of that shooting season, that is, January 31st next ensuing. For a station operating in the spring all the returns would be used that came to hand during the whole of the next shooting season. Thus the year under con-



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sideration would begin February 1st and end January 31st.

We will not consider the absolute totals of returns which may be obtained in any group over a series of years, or theoretically during the lifetime of the individuals which are marked. One reason for not laying stress on this figure is that many bands may be worn out and lost after two or three years, so that this percentage rate of final return may appear much less on the books than it really is in nature. It is a very surprising fact to find how few of the marked ducks which escape two or three shooting seasons ever come to hand. Do they tend to learn wisdom with age, do they get rid of their bands, or do they die a natural death earlier than we have thought probable? These questions are of tremendous practical interest to the conservationist.

There is another variable to be considered some day and that is the different artificial mortality rates calculated as to species. Study along these lines may throw much light upon the actual chances which the different kinds of waterfowl take in running the gantlet of a shooting season. The figures for such a study on a large scale are already available. We would like here to call attention to some curious facts which deserve much more study. The gross mortality for all Mallards (nearly 16,000 of them) is 15.7 per cent. Black Ducks give us only 13.7 per cent of returns, and Pintails only 10.7 per cent. Blue-winged Teal banded at Ellinwood, Kansas, in the spring, gave less than two per cent, while another group from Avery Isle, Louisiana, gave twenty-five per cent.

But to return to a consideration of the average annual mortality rate (artificial). This appears from

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the studies of one of us to run from about ten per cent to a little over fifteen per cent, taking into consideration all species and all banding stations at different seasons of the year. The annual mortality average is, therefore, about thirteen per cent for the first season after banding.

We should explain further that this figure is arrived at mostly from the operation of ten banding stations scattered from Maine and Ontario to Utah and California. These stations are well chosen and have provided returns from as far northwest as the Arctic Coast of Alaska and as far south as British Honduras for our common shoal-water ducks. These ought to and do give us a good cross-section of actual conditions in so far as the gun is concerned.

We still need to band large numbers of the diving ducks in order to see whether they fare worse or better than the surface feeders.

The heaviest mortality rates yet discovered in any one group of ducks was found for autumn banding at the Sanganois Club near Browning, Illinois, where the artificial mortality rate reached was over twenty per cent the first season. Blue-winged Teal banded in winter at Avery Isle, Louisiana, showed twenty-five per cent of returns, while the Redheads at Dawson, North Dakota, gave us eighty-four per cent! To this known destructive factor we must add an unknown destruction of great importance, namely, all those birds which are killed and lost or go off wounded to die later on. Estimates vary very much as to the actual percentage of crippled birds. One thing is certain, that the proportion of wild-fowl hit and lost is very much greater to-day than it ever was before. The reason for this is

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obvious to almost any one acquainted with public or semi-public shooting areas to-day.

If, now, we wish to let our mathematical imaginations run riot for a moment, we may add this thirteen per cent of average artificial mortality to the natural mortality already discussed of around fifteen or twenty per cent, which would give us the high rate of twenty-eight to thirty-three per cent. Such a rate must certainly leave a very small margin of safety; indeed, it can scarcely do more than just balance the average natural summer increase of the stock.

Fifty years ago it is safe to say that fifty or sixty per cent of all ducks shot were killed by market shooters. The bulk of the remainder were killed by men who were wild-fowl hunters from boyhood and who knew how to judge distances and how to shoot effectively. Conditions now are just about as different as possible. A larger and larger proportion of ducks are shot at by inexperienced persons who are no judges of distance and have never had the opportunity to become experienced shooters. Consequently, ducks are shot at regardless of what the range may be. Far more important still is the more general use of automatic and pump guns, which has had and is still having serious consequences. In the hands of market shooters these highly efficient guns were simply an aid in killing a larger number of ducks. In the hands of the novice they are largely instruments which increase the chances of crippling over those of killing. The fault is not so much with the guns as with human nature stacked up behind them. Greater speed in discharging shells has led to more careless shooting; the hunter depends upon a barrage fire rather than on a clean double shot, and

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the consequent waste of wild-life is something which we must take seriously to heart.

If we were asked to place the total loss of wild-fowl in the United States through cripples and dead birds never recovered, we should be obliged to add at least thirty per cent to the annual bag, say roughly from two million to three million birds. These lost birds serve no useful function whatever, but merely increase the available food-supply of semi-wild hogs, cats, and natural predatory animals of marshes and lake shores. Sportsmen, once at least, were vastly interested in bags cleanly won — that is, in straight shooting — and the real sportsman still is. Conditions vary, of course, but given good average conditions and ducks coming in well over decoys, three shells per bird, including all those fired at cripples, was considered a fair average performance day in and day out. Very good shots could do better, of course, but poor shots could never begin to equal this over a period of several days.

Now, take modern conditions on an opening day in almost any public shooting area. Repeating guns are the rule rather than the exception; shells are purchased with the idea of a general celebration rather than the pursuit of sport and are used with the liberality of fire-crackers on the Fourth of July. We are certain that there are many ducking areas where there is not one duck retrieved for every twenty or twenty-five shots fired. Opinions of experts differ, but the average number of shells fired to-day from the East to the West Coast for every duck or goose brought to bag has been placed as low as twelve or fifteen and as high as twenty-five or thirty.

We have now to glance at the map of the United



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States and with what figures we can summon to our aid make a State by State survey of the ducking conditions. In some of these States, namely, Massachusetts, Connecticut, New York, Pennsylvania, Maryland, Virginia, North Carolina, Louisiana, Minnesota, and California, we have figures which are of real value in getting at a rough estimate for the United States as a whole. In other States the wild-fowl resources of the important areas are fairly well known and we can get an idea of the total bag for those States. In a great many other States we know that few ducks or geese are shot, because, owing to mountains or deserts, there are no large areas of concentration.

We are not going to puzzle our readers with a detailed analysis of annual kills considered as to States. This chapter is already far too long. We may take a conservative view and place the total of ducks shot in the United States as 8,000,000 or 9,000,000, and of geese 100,000 to 150,000. The marine Brant are not considered here. We must make it clear that this is little more than an intelligent guess. For Canada we may add 1,000,000 to 1,500,000 ducks and 50,000 to 100,000 geese, exclusive of those shot by Eskimos in the far-Northern fur countries. Our knowledge of Alaska is not extensive enough to hazard even an 'intelligent guess.'

We may now ask whether we have any statistics which help us to judge what proportions of the total number of wild-fowl shot in the United States are taken by shooting clubs? This question can be answered by another 'guess' based on some figures in the files of the Bureau of Biological Survey and the American Wild-Fowlers. It appears from a study of these records,

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which were assembled in 1927 and 1928, that there are in the United States at least two thousand legitimate ducking clubs and private preserves. Most of these are situated along the middle Atlantic Coast, the Gulf Coast of Louisiana, the lower Mississippi Valley, the Illinois River, and in Colorado and California. For example, there are over one hundred clubs in Maryland, Virginia, and North Carolina. Some four hundred along the Illinois River in Illinois (many of which are of a commercial or semi-commercial nature), and perhaps three hundred in California, some of these also highly commercialized.

In response to a letter enclosing specially prepared blanks, a certain proportion of these clubs responded with a copy of their records showing the numbers of each species shot. Many clubs did not respond at all, and many others stated that they kept no records. Nevertheless, we have enough material, from a large number of clubs scattered from the Atlantic to the Pacific, but chiefly in Maryland, Virginia, North Carolina, Arkansas, Illinois, and California, to make a rather close estimate of the average number of ducks taken at ducking clubs throughout the country in any one year. This number appears to be about eighteen hundred wild-fowl per club, and it was further brought out from the reports of the number of guns on the various shooting days that the daily average bag per club member was, in the season 1928-29, about twelve ducks, or rather twelve wild-fowl. This is of interest in checking some of the exaggerated statements put forward by the proponents of radical restrictions in bag limits.

If this group of clubs which sent in reports is a fair

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sample of the two thousand-odd clubs of the whole country, and we think it is, then the clubs alone would account for about 3,500,000 ducks and geese a year, or say from 3,000,000 to 4,000,000. If we hark back to our conservative guess of 8,000,000 to 9,000,000 for the United States as a whole, we may hazard an opinion that the clubs and preserves are now shooting about one third of all the wild-fowl killed in the United States. That this proportion has increased in the past ten years, nobody doubts, and it is more than probable that it will increase still more in the future. The proportionate numbers shot in commercialized or semi-private areas by visiting sportsmen also increase as valuable waters become less and less available to the unorganized shooter seeking 'free' sport.

While we are still on the subject of clubs and club records, it is interesting to note the numbers of each species as they were reported by the clubs. The number of geese of all species represented less than one and one half per cent of the total number of wild-fowl. This checks up fairly well with our guess of 100,000 to 150,000 for the whole United States, mentioned earlier in this chapter.

In order of abundance the ducks shot by the clubs were as follows: Mallard, Pintail, Ruddies, Scaup, Canvas-back, Blue-winged Teal, Green-winged Teal, Baldpate, Spoonbill, Black Duck.

The proportion of Ruddies is much too high to be representative of the country as a whole, for the reason that over forty thousand of them were reported from California alone. The rest of the species as listed above probably represent about the normal order of abundance for a cross-section of the game wild-fowl population.

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One fact seems significant. The Redhead, once one of the most abundant of all the sporting diving ducks, appears on our list as fourteenth from the top, ranking close beside the Ring-neck. There were three and one half times as many Canvas-backs taken as Redheads.

The preponderance of the Mallard over the Pintail, 95,500 as against 62,000, suggests the possibility that more Mallards are shot relative to their numbers the country over than Pintails, for the Pintail has a wider range, both summer and winter, than the Mallard. It is quite possible that man, through the use of the shot-gun alone, may inflict radical changes upon the relative numerical status of certain species of ducks without greatly affecting the stock of wild-fowl as a whole. At least this aspect of the problem will have to be considered in the future when it is to be hoped far more basic information will be available for estimating wild-fowl populations.

The destruction of game wild-fowl by natives in the far North is certainly not a serious factor. There has always been a temptation to blame Indians and Eskimos for the losses which we could easily account for without going far from home. Eskimos, Indians, and the Labrador fishermen have worked havoc among sea ducks, chiefly eiders, as well as among the auks, guillemots, murres, gulls, and other rock-breeding species. But the great majority of game wild-fowl are not concentrated in easily ravished breeding colonies where they can be destroyed on a large scale. In Alaska several species of geese are driven into nets before they can fly, chiefly Emperor and Cackling Geese. Here and there Snow and Blue geese probably



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afford food for Eskimo tribes during the summer, but such destruction has certainly not increased in the past fifty years, and it may be very much less now than it was formerly.

Some of the fur posts along the shores of Hudson Bay have always relied upon the flesh of geese to help out the winter provisions, and a great many thousands were annually salted away. This, however, is a perfectly legitimate custom, and certainly cannot be checked until these regions are brought in closer touch with centers of civilization.

This chapter has of necessity dealt largely with what our oversensitive friends and the public press like to call 'slaughter.' The figures we have quoted are large, but they should not alarm us, for they show that our stock of wild-fowl is still enormous, though doubtless much less than formerly.

There is one factor of compensation which should never be lost to sight. Its importance cannot be too often stressed, and without it we believe that game wild-fowl would have nearly disappeared years ago. We refer to the adaptability of most species in acquiring new habits as soon as persecution becomes severe.

It is an actual fact that under present-day concentration of guns some ducks learn more in a day or two than they could have learned during a whole autumn two or three generations ago. Given a safe day resting ground, wild-fowl soon adopt habits of daily flights which render them fairly safe from the gun of the sportsman except during great stress of weather. With a few notable exceptions all game wild-fowl are yearly becoming wilder. In this way the over-gunned public areas may become relatively safe for ducks until the

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disturbance from guns and motor boats becomes so great that the game is driven away completely.

On the other hand, the well-looked-after preserve can maintain its wild-fowl, and hence its shooting, by carefully controlling the disturbing factors. We mention this to show that the noisy duck marsh may be the safest, temporarily at least.

We have tried in this chapter to give some idea of the relative damage caused by the gun on our stock of migratory wild-fowl. We have tried to show that, with the increase of shooters, the maintenance of a strictly democratic system of so-called free shooting would turn the odds against the birds to an overwhelming extent.

In this connection the club and preserve idea has developed as the natural outcome of a diminishing supply of game confronted by an increasing army of shooters. And this army is to-day operating upon marsh and water areas which are reduced to only a fraction of their former extent.

We have pointed out the absurdity of the theory that there would be plenty of ducks and geese to satisfy all sportsmen if all the preserved areas were opened to the public.

So that any adjustment of opportunities between those who have, and those who have not, must take into consideration the conditions as they actually exist, not as we would like to have them in some future millennium.



## CHAPTER III

### POISONS, DISEASES, AND PARASITES

IN THE preparation of this chapter it has not been our aim to present detailed diagnoses and pathological discussions of the various ailments that affect migratory wild-fowl. Wild ducks, like all other wild animals, are subject to many ailments; most of which are obscure and little understood. Outbreaks of sickness among them sometimes occur at widely separated localities and unless investigated immediately by a competent specialist frequently they cannot be explained. Extensive studies, both in the field and in the laboratory, must be conducted before many factors can be fully recognized. Accordingly, it has been our purpose to present a review of the known facts, describe the external symptoms, and certain morbid appearances, by which some causative agencies may be recognized; also to discuss briefly the areas where there have been serious outbreaks of disease, whether caused by mineral poisons, bacteria, protozoans, or other parasites.

## POISONS, DISEASES, PARASITES

For obvious reasons, special attention will be given to alkali and lead poisoning, as present information indicates that these are the most important.

The task of the investigator of the diseases of wild-fowl is rendered more difficult for the reason that very few sportsmen, conservationists, or game officials have had training in pathology, and in consequence, when they write to an expert on the subject, they either describe no symptoms at all, or at best give only the very general ones that may be common to maladies caused by entirely different agencies. To say that ducks 'acted dumpish and died after sitting or swimming around for a few days' is to present no information that will lead to a diagnosis. Yet the fact remains that the birds did die, and officials charged with the protection and perpetuation of an abundant stock of waterfowl are concerned to know the cause of the mortality reported.

The results of disease among North American waterfowl have been particularly serious in the Western States, chiefly those west of the Rocky Mountains, but outbreaks of more or less severity have also occurred east to the Dakotas, Kansas, and Louisiana. Occasionally local cases are reported from the ducking marshes of the Atlantic Coast, as New Jersey, Maryland, and North Carolina. Frequently these have been diagnosed as lead poisoning. (See section under 'Lead Poisoning.')

As we have previously pointed out, wild-fowl show a marked tendency to remain constant to their own longitudinal part of the continent, even in the cases of species that have a more or less general distribution over the entire area. For this reason the disease out-



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breaks in the West are particularly disastrous and it is conceivable that because of them it might be necessary to shorten shooting seasons or bag limits, or even entirely close the season in a vast territory, while at the same time, the conditions being normal in the Mississippi Valley and on the Atlantic Coast, good sport would be available with birds in abundance. To emphasize this, it is only necessary to recall that during the worst year of the 'duck sickness' on the great Bear River Marshes of Utah, as many as 46,000 dead ducks were gathered up and buried, and the State Fish and Game Commissioner estimated the loss that year (1913) as from 1,000,000 to 2,000,000. In one year (1914) it was estimated that by August 21st, within a distance of two miles along the north channel of the Weber River, between 8000 and 10,000 ducks were dead. Dr. E. W. Nelson, former Chief of the Biological Survey, has stated his belief that since 1902 the loss of ducks in the West from disease has been in excess of 15,000,000.

With this introduction to the subject we may now take up the various causes of waterfowl mortality from poison and disease, review their history, and present such information concerning them as has been determined by properly qualified investigators.

### POISONS

The deliberate poisoning of wild-fowl is, of course, so rare as to be almost negligible, although the 'American Field' for February 11, 1899, reports the wholesale poisoning of ducks and geese, in the vicinity of Yuba City, California, where the birds had become so enormously abundant that they were destroying crops.

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The two chief sources of poison — alkali and lead — are, however, usually traceable indirectly to the activities of man, the former through drainage and irrigation projects and the latter to lead shot, the remains of shotgun charges scattered over feeding grounds. It accordingly becomes the clear duty of all those interested in the perpetuation of these birds, to do all in their power to rectify such conditions.

*Alkali poisoning.* — Although probably observed on earlier occasions, the first definite notice of a high death-rate from what was seemingly this cause is the report of Dr. A. K. Fisher, of the Biological Survey, who, in 'North American Fauna,' No. 7,<sup>1</sup> refers to the finding in June, 1891, of the bodies of thousands of Eared Grebes, and 'a large number' of Shovelers, around the shores of Owens Lake, California. Dr. Fisher counted the bodies of grebes found within the limits of a given distance, and with this as a basis estimated the total for the entire shore line as 35,000. In commenting on this case he states: 'Either the water, which is saturated with salt and soda, is in some way injurious to them, or remaining to search for proper food, which does not exist in the lake, they become so weak from innutrition as to be unable to fly and die of starvation.'<sup>2</sup>

Drought conditions, which are not infrequent in the West, may have played an important part in this case, as they have figured prominently in the serious outbreaks of recent years. Nevertheless, in a considera-

<sup>1</sup> *The Death Valley Expedition*, Part II, pp. 12-13, 17; United States Department of Agriculture, Washington, D.C., 1893.

<sup>2</sup> Dr. E. W. Nelson, also a member of the party working at this point, recently told me (December, 1929) that he was of the opinion these birds died from starvation. — F. C. L.

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tion of these more disastrous cases of alkali poisoning that have occurred during the present century, there can be but little doubt that the drainage and irrigation works of man have been not merely a contributing factor, but the principal cause. Many of the large Western lakes and marshes are heavily charged with alkali, but frequently the saturation is so nicely balanced that, with a normal water-level, they are comparatively safe as breeding and feeding grounds. If, however, they are seriously lowered, they become veritable death traps, and at many points this is exactly what has happened.

Before attempting to discuss the more recent outbreaks of 'duck sickness,' it seems well to present an account of the investigations made by Dr. Alexander Wetmore (now Assistant Secretary of the Smithsonian Institution), which covered exhaustive field and laboratory work in the Bear River Marshes, Great Salt Lake, Utah. As a result of this work the malady that had so decimated ducks and other birds in that area was definitely ascertained to be alkali poisoning. As the conditions are apparently similar at other Western lakes and marshes, it is advisable to treat his findings at some length. The following account is taken largely from Dr. Wetmore's two reports on the subject,<sup>1</sup> and in places is practically a verbatim transcription, action on our part that we believe to be justified since the original reports are now out of print, and, moreover, Dr. Wetmore's phraseology is an excellent description of the conditions, both as to cause and effect.

<sup>1</sup> *Mortality Among Waterfowl Around Great Salt Lake, Utah, and The Duck Sickness in Utah*. Bulletins 217 and 672, United States Department of Agriculture, issued May 26, 1915, and June 21, 1918.

## POISONS, DISEASES, PARASITES

The fact that ducks were dying from an unknown cause on these great marshes was apparently noted as early as 1896, and it was a matter for comment in the newspapers of Ogden and Salt Lake City by 1908 or 1909. It was not, however, until 1910 that attention became definitely focused on the so-called 'duck sickness.' That was a very bad year, with a dry summer, and the water-levels of the rivers were much below normal. Literally thousands of birds died on both the Jordan and Weber Rivers, while on the great mud flats in the Bear River delta, the mortality was terrific. Long windrows of bodies were blown up on the shores, and the shallow bays were dotted with dead birds. The duck clubs did not open in the autumn because of a strong prejudice that arose, many persons being even afraid to handle or be near the affected ducks. Stories became current that people and domestic animals had contracted disease through contact with the ducks. On the New State Gun Club at the mouth of the Jordan River, large numbers of dead ducks were picked up by men hired for the purpose, piled in heaps, and covered with lime. In this district the cause of the disease was attributed to typhoid or some other obscure infection brought about by sewage from Salt Lake City, but in 1911 the outlet to the sewer had been carried beyond the marshes, so that sewage as a possible factor was largely eliminated.

In 1912, conditions were again bad, and between August 22 and September 21, 44,462 dead ducks were gathered and buried on Bear River alone, with 30,000 more on the Weber River flats. Again, in September, 1913, there was a serious outbreak, and in that month 46,723 dead birds were gathered in the Bear River Marshes.



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Congress now took note of the situation and made a special appropriation to enable the Biological Survey to make a detailed study of the problem. In consequence, during the seasons of 1914, 1915, and 1916 (the two latter years from May to the last of October), Dr. Wetmore was actively engaged on the Bear River Marshes. A field laboratory was erected and careful systematic studies were made of the conditions found in the marshes, of the symptoms of affected birds, their reactions to various salts, and the anatomical condition of those that died, this last being determined by many dissections and technical laboratory studies. In order that the many theories advanced might be fully tested, efforts were made to isolate an organism capable of transmitting the trouble from one bird to another. Intravenous and hypodermic transfusions of blood were made, healthy birds were confined and fed with grain treated freshly with feces taken from affected individuals, and were even forcibly fed on fragments of organs, or the entire stomach and intestinal content of sick birds. All of these experiments gave negative results.

Superficially this malady presents many resemblances to avian cholera, but examination of hundreds of specimens failed to show the characteristic cholera lesions, while blood obtained from the peripheral circulation, as well as the heart, and examined microscopically, gave negative results. Healthy and sick birds were confined in the same pens, with no attempt to avoid possible transmission of the trouble, but in no case did any of the normal birds contract the sickness. If it were contagious or infectious, cases would have surely resulted under such treatment.

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One theory advanced and for a time given considerable credence, even by scientific investigators, was that the birds were poisoned by sulphurous or sulphuric acid resulting from waste from the great smelters near Salt Lake City, or the sugar factories that are located on each of the three rivers where sick ducks occur. It was found, however, that ducks were able to stand for a considerable period solutions of sulphuric acid that were strong enough to be very sour, certainly a much heavier concentration than they were getting in a state of nature. Various other minor hypotheses were advanced, but all were found untenable.

The result of this study was to establish definitely 'that the duck sickness in Utah is caused by the toxic action of certain soluble salts found in alkali.' By actual experiment Dr. Wetmore produced the disease by administration of the chlorides of calcium and magnesium.

As the amount of arable land under cultivation has increased in the Salt Lake Valley, the stream-flow at the river mouths has correspondingly decreased due to the withdrawal of the water for irrigation. The result is to induce stagnation and expose great expanses of mud flats in the marsh areas. Surface evaporation and capillary attraction rapidly draw the salts to the surface of the mud, where they become concentrated, and as the drying process continues these concentrates become visible as a white deposit or 'efflorescence.' In the large bays strong winds bank up the water and blow it in across these drying mud flats. As it advances, it rapidly takes these salts into solution, and while they are chiefly sodium chloride, compounds of calcium and magnesium also are represented in varying amounts.

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This inflowing water carries with it great quantities of seeds, bugs, beetles, and spiders that are floated out of crevices and holes in the dried and cracked mud. The ducks eagerly avail themselves of this easily secured food and work rapidly along at the front of the advancing water. In this way a lethal dose of poison is obtained. As the water recedes again, small ponds are left in shallow depressions, and to these other ducks and shore birds come to feed. Rains also are responsible for the formation of shallow pools and ponds which become strong with the salts held in solution.

Thirty-six species of birds that are listed by Dr. Wetmore unquestionably had contracted the duck sickness. These include two species of grebes, two gulls, two terns, the White Pelican, nine ducks, the Canada Goose, the White-faced Glossy Ibis, the Snowy Heron, the Coot, and ten shore birds, as well as such land species as Blackbirds, Horned Larks, Magpies, and Cliff Swallows. In addition sixteen other species of birds were found under such conditions as to indicate that they had died from the same trouble. (Since Dr. Wetmore's work was completed this list has grown until now [1930] it is about sixty species.) Muskrats, frogs, and even large beetles, also were apparently affected.

The symptoms of alkali poisoning indicate a paralysis of the nerve centers controlling the muscular system. Some affected birds may be able to support themselves in the air for a short distance, or the wings may be entirely helpless, with all intermediate conditions existing. The paralysis is at first most apparent in the great pectoral muscles. The smaller muscles that support the wing when folded also relax and allow the carpal joint to drop from its normal position so that the wings



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droop from the sides of the body, and in swimming the anterior wing joint will drag in the water, frequently forcing the wing tips up conspicuously at an angle above the back. The paralysis next spreads to the leg muscles, and the sick birds, apparently sensing the increasing helplessness, will endeavor to work their way out of the water, and if available seek shelter in rushes or other plant-growth. The neck muscles next weaken and support the head with difficulty. If in the water, death may now result from drowning, although if the birds are on land they may live for some time longer. Many avert drowning by throwing the head on the back, where it lies in an unnatural position.

Considerable difficulty in breathing is an early symptom, due to the partial paralysis of the muscles controlling this function, and in severe cases the heart is affected. The temperature is likely to remain about normal, but if the heart is affected it will fall slowly from the normal mean of about 106 degrees Fahrenheit to less than 100 degrees.

An important external symptom that appeared to be diagnostic with the Bear River cases was the early paralysis of the muscle controlling the third eyelid or nictitating membrane. When a normal healthy bird winks, this membrane, which has a milky appearance, is drawn rapidly across the eyeball from the lower anterior corner of the eye. To test for alkali poisoning, it was necessary only to hold the bird's head firmly and, with some slender object as a toothpick or piece of grass stem, gently touch the eyeball near the posterior corner and observe the action of this third lid. If the bird was not affected by alkali, the lid would spring back at once, perhaps several times, in an effort to pro-



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tect the sensitive surface. With birds slightly affected by alkali, the movement was slow, while in more serious cases, the membrane came only part-way across the eyeball, or remained motionless in its normal position. Dr. Wetmore stated this to be an infallible test for alkali poisoning, but more recent work by other investigators at other points suggest some doubt as to whether or not it may be universally relied upon.

There are various other symptoms that are correlated with this ailment, such as the swelling and copious discharge from the large gland that lies within the orbit on the anterior surface of the eyeball, and the marked irritation of the intestine that is shown upon dissection. We have, however, shown the nature and cause of this disease, and it is believed described it sufficiently to enable an observant sportsman to recognize it when found.

Fresh water is an almost certain cure if the affected bird is not too far gone. The treatment worked out by Dr. Wetmore was merely to place sick birds in pens with access to an abundant supply of clean, fresh water. Before doing this a dose of castor oil (one cubic centimeter for teal and twice that amount for larger species) may be administered with a medicine dropper inserted well down the bird's gullet, being careful to avoid the windpipe. This purgative cleans out the intestinal tract and has a soothing effect upon the irritated membranes. In 1926, the junior author had occasion to test this treatment while working with ducks on these marshes. Its effectiveness was almost complete, and it was rare for a sick duck actually to die if alive at the time it reached the recuperation pens.

A debt of gratitude is owed to Dr. Wetmore for his

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complete and exhaustive investigations, and it is hoped that when the Bear River Marsh Refuge is fully completed, with adequate dikes and levees to impound a constant supply of fresh water, losses from this cause in these great marshes will be largely eliminated.

Since the conclusion of the work by Dr. Wetmore, however, ducks have continued to die in great numbers, not only in the Bear River Marshes and adjacent areas, but also at many other points in the Western States. The affected area has extended from California and Oregon east to the Dakotas, Nebraska, Kansas, and Texas, and from Alberta and Saskatchewan, south to the State of Durango in Mexico. In the northeastern part of this State, near the town of Tlahualilo, several thousand Pintails, Blue-winged Teal, and Sandhill Cranes were stated to have died in the autumn of 1925, the fragmentary report indicating alkali as the probable cause. At the conference of Game and Fish Commissioners, held in St. Paul, Minnesota, during September, 1929, David H. Madsen, Superintendent of the newly created Bear River Marsh Refuge, reported that the loss of birds in Utah during August and September, 1929, was in excess of 100,000.

Despite the seemingly conclusive work of Dr. Wetmore, the entire gantlet of possible causes has again been run by persons rendering reports on local conditions, some even going so far as to indicate their belief in the possibility of transmission of the disease to human beings. As an example of this, a county health officer in Oregon, acting on the theory that an outbreak of disease in the fall of 1925 might be caused by some form of botuloid poisoning, issued a general warning to all persons not to eat affected birds. It must be

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admitted that there are still many perplexing angles to the problem, as studies in different regions by competent investigators have yielded results that do not entirely check with the pioneer work of Dr. Wetmore. On the other hand, it can be hardly coincidence that *all* important outbreaks of duck sickness have occurred in the West, either in districts with a heavy concentration of alkali or in others adjacent to them. In other words, it is our belief that whatever the final solution may be it will be found that the presence of mineral salts is a prerequisite to its development. During the early autumn of 1929, the junior author had opportunity for some enlightening observations while engaged in field work in North Dakota. At a large shallow water area known as 'Big Alkali,' located in Kidder County, ducks, shore birds, and others died in large numbers, a conservative estimate placing the mortality at 20,000, or 1000 dead and dying birds per mile of shore line. The shores were merely extensive mud flats with an efflorescence of alkali. The symptoms did not entirely check with those considered typical for alkali poisoning, and the percentage of recovery under the fresh-water treatment was very low, the conclusion being either that other factors were involved or that the poison was so virulent that a lethal dose was rapidly acquired by the birds. The interesting discovery, however, was the fact that another lake, 'Des Moines Lake,' located about thirty miles north, had on its shores a much heavier efflorescence of alkali. This lake also contained abundant duck food, and while large flocks of ducks were resting on its surface, a careful search failed to reveal a single dead or dying bird. In commenting on

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this case in a letter to Mr. Nash Buckingham, Executive Secretary of the American Wild-Fowlers, the theory was advanced 'that the toxic quality of alkali depends upon the proportion of the different salts that are contained in it; in other words, while a general concentration of alkali at one point might be much heavier than at another, the heavy concentration might not contain the particular salts that are fatal to ducks.' This letter was published by Mr. Buckingham in 'American Game' for October and November, 1929. Possibly other factors, such as parasites, gases, bacteria, etc., may be contributory, but alkali of certain composition and proportion is apparently a necessary corollary.

In addition to the outbreaks at the Bear River Marshes, the trouble has been particularly serious in California and Oregon. The Biological Survey has again taken up the study of the problem, and following preliminary work by Mr. Charles C. Sperry in the summer of 1927, Mr. E. R. Kalmbach established a well-equipped laboratory at Klamath Falls, Oregon, and spent several months in 1929 making an intensive investigation of the subject. Mr. Kalmbach is well fitted to conduct this research and with the coöperation of other specialists and organizations it is to be hoped that a complete solution ultimately will be obtained.

*Lead poisoning.* — Mortality of waterfowl from lead poisoning is of common occurrence. It is probable that this 'disease' is much more prevalent at every important ducking marsh than is generally known, as literally tons of expended shot have been scattered over such areas. In common with other birds that have a muscular gizzard, ducks, geese, and swans require



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certain quantities of grit for the proper grinding of food before it can be passed on to the intestines for assimilation of the nutritive content. When feeding, these birds have a tendency to swallow any small hard objects that are encountered, and as they will frequently work over the bottom mud to a depth of a foot or more, it is easy to see that many pellets of shot may be taken. It has been determined experimentally that six pellets of No. 6 shot constitutes a dose of lead that is always fatal.

It also is possible that a lethal dose of lead may be obtained from waters that are contaminated by the refuse from lead mines. This appears to have been the cause of the death of many Mallards, Pintails, and Teal, near Riverton, in southeastern Kansas, during February, 1923. When first reported, it was thought that the birds were dying of starvation, but investigation showed them to have well-filled crops. The general symptoms checked well with our knowledge of lead poisoning, and it seems probable that the lead originated at mines which were known to dump their refuse into Spring River, where the affected birds were found.

Here again we are indebted to the comprehensive experimental work of Dr. Wetmore in determining the nature of this disease, and we have drawn extensively from his report on the subject.<sup>1</sup> His description of the symptoms and *post-mortem* appearance may be summarized as follows:

The symptoms of lead poisoning as observed in waterfowl are similar in many ways to those found in mammals. A prominent indication of this malady is

<sup>1</sup> *Lead Poisoning in Waterfowl*. United States Department of Agriculture. Bulletin 793, July 31, 1919.

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the progressive paralysis of important muscles, as those of the legs and wings. The affected bird frequently has trouble in walking and may fall as it attempts to turn around. Finally the legs will be so paralyzed that the body cannot be supported and the bird will move about by sliding on its breast. If in the water the wings will float loosely on the surface, while on land the tips of the primaries may drag as the bird walks about. The feces are thin and watery and stained green, this color being a well-marked symptom, as it is remarkable for its brightness. The eyes are very bright and the nictitating membrane is not affected, this latter fact frequently being a ready means of distinguishing in the field between birds suffering from lead and alkali poisoning.

Although the body temperature is likely to be normal, the heart is, nevertheless, affected, and birds suffering from lead poisoning may die suddenly from fright or exertion. Birds with lead poisoning always show good appetites and eat eagerly, while they drink copiously and at short intervals. When disturbed, they may regurgitate a greenish fluid or watery discharge that stains the tongue and mouth cavity.

Dr. Wetmore states that at *post-mortem* the flesh of birds dead from lead poisoning is nearly always pale in color, probably due to a decrease in the number of red corpuscles in the blood. In prolonged cases, the crop, lower æsophagus and proventriculus, or glandular stomach, are likely to be greatly distended with food, while the gizzard proper, because of the paralysis of its great muscles, may be nearly empty. The gizzard contents usually are stained green. The gall bladder is always full and may be much distended, the bile being

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very dark green in color, which after death may slowly spread until the entire liver is stained.

The usual number of shot pellets found in one stomach was fifteen to forty, and the largest number taken from a single bird was one hundred and fifty, which were found in the gizzard of a Black Duck secured in the Potomac River, near Washington, D.C. When the shot have been in the gizzard for a considerable time, they show great wear, in many cases ground down to small, flattened disks by the action of the stomach muscles and the grinding gravel.

The presence of shot in the stomachs of wild-fowl has been for many years a subject for discussion among sportsmen. In the 'American Field' for March 24, 1894, notice is given to the seizure and condemnation as unfit for food by the health officer of Galveston, Texas, of two lots of ducks killed at Stephenson's Lake. The disease at that point already had been noted for twenty years. This lake, and Lake Surprise in the same region, supported luxuriant growths of wild celery which attracted large numbers of ducks, chiefly Canvas-backs, and so were meccas for hunters.

Dr. George Bird Grinnell, in his book, 'American Duck Shooting,' published in 1901, describes the effects of lead poisoning as observed by him on ducks, geese, and swans in Currituck Sound, and an examination of several Whistling Swans sent to the Biological Survey from Back Bay, Virginia, in January, 1915, revealed from twenty-two to forty-five pellets of shot in the gizzard of each bird. It has been reported that at Houghton Lake, Michigan, in May, 1928, some Scaup Ducks were killed by this malady. This species also appeared to be the chief victim on the grounds of a

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former duck club on Nehalem Bay, Oregon, where during the winter of 1924-25, S. M. Batterson, of Mohler, Oregon, caught several that 'acted stupid and sick.' Upon dissection he recovered from half an ounce to two ounces of shot from the gizzards of these birds.

At Hovey Lake, near Mount Vernon, Indiana, in February, 1922, 'thousands' of ducks were reported as dying from an unknown malady. Upon investigation by a specialist from the Biological Survey, it was found that, although ducks were dying at that lake, the report was much exaggerated. Specimens brought in and examined in the laboratory were found to have been killed by lead poisoning due to eating shot.

Possibly the most serious condition exists in Louisiana, where duck mortality from this cause may sometimes be further complicated by internal parasites and possibly at times by lack of food. (See section on 'Parasites'). The great coastal marshes of this State, which are the winter home of myriads of wild-fowl, are extremely deficient in sand and gravel, and as they are justly famous shooting grounds, it is not surprising that the birds that congregate there should pick up lethal doses of lead in the form of expended shot. The affected area is in the rice belt and a fanciful theory advanced by a local resident was that the birds had acquired the human disease known as beri-beri, which is brought on by a heavy rice diet. Press statements in January, 1925, reported 'thousands' of ducks dying, and as it was thought that the malady was contagious it was feared that it would spread over the entire State. People were warned not to eat waterfowl during that season. All birds that were picked up and examined



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by specialists competent to pass on the trouble were found to have died from lead poisoning due to ingested shot.

In the Jacobs and Pecan Lake region of Arkansas, large numbers of ducks died from this disease, also in January, 1925. Clark McAdams, of St. Louis, Missouri, in commenting on this case stated that, while it had not been noted in previous seasons, hunting had been intensive for years, so that the country was undoubtedly covered with shot. The season of 1924-25 was marked by a scarcity of duck food with drouth conditions and much shallow water. Starvation probably had some effect, as the scarcity of food might well cause more of the foraging birds to pick up and swallow fatal numbers of shot pellets.

From this account it will be seen that lead poisoning due to eating shot is of common occurrence, and it seems reasonable to presume that the disease will continue and even increase in the great ducking marshes of the country. The ultimate conclusions as to its effect upon the supply of waterfowl are hazardous to imagine, but it is worthy of note that Dr. Leon J. Cole of the University of Wisconsin, has found that lead administered to male domestic fowls has the effect of seriously reducing their virility, and that the vitality of the offspring is distinctly affected. Should such prove to be the case with wild-fowl, it will be seen that the poison may become a serious detriment even in those birds that are tolerant or recover from its effects. Dr. Wetmore states that no practical suggestions can be given to alleviate the danger to wild-fowl from this cause. He was able to cure some individuals by the administration of magnesian sulphate (Epsom salts)

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in a solution of sixty grams of the salt to ten quarts of water. This forms an insoluble compound with lead and so serves to neutralize the effects. This is of interest, but the results are somewhat uncertain and the treatment obviously has no practical value in reducing this hazard to our migratory wild-fowl.

*Phosphorus poisoning.* — The poisoning of water-fowl by phosphorus is so unusual as to be properly classified as accidental, but, since the only known instance has received much attention from the press and sporting periodicals, it is desirable that we include in this work a brief account of the case.

On May 19 and June 6, 1923, and in the pursuit of War Department routine experimental work, 332 shells, each loaded with nine pounds of phosphorus, were fired from Aberdeen Proving Grounds, and exploded over a tract of water of about twenty-six acres in Spesutia Narrows, Chesapeake Bay. It was an unfortunate coincidence that this area supported a large bed of wild celery, a favorite food of the Canvas-back. The phosphorus particles not consumed before striking the water sank to the bottom, where, protected from the air, they remained a constant source of danger to any animal that in feeding in the celery bed might swallow them.

Reports of dead Canvas-backs in this region soon began to come in, and in December, 1923, specimens examined by Dr. E. A. Chapin, then of the Bureau of Animal Industry, United States Department of Agriculture, were found to have died from swallowing bits of phosphorus. All subsequent work in connection with this case was done in the Division of Food Habits Research of the Biological Survey. In March, 1924, a

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representative of the 'Baltimore Sun' reported that in a stretch of three miles south of Betterton, Maryland, he found 'at least six thousand Canvas-backs dead, two swans which were partly eaten, and numerous carcasses of other swans.' In one cove he claimed to have counted 327 dead ducks, and he stated that dead bodies could be seen lining the shores as far as the eye could see.

An investigation was promptly made by the Biological Survey, and while it was thought that the estimates as to the numbers of birds killed were much too high, it was nevertheless apparent that a serious condition existed. The Commanding Officer of the Proving Grounds coöperated and in order that there might be no repetition of trouble from this cause, a general order was issued in 1924 forbidding 'the dropping of any projectiles containing phosphorus or other substances of presumptive danger to wild life, bird, animal, or fish into the waters in the neighborhood of the Proving Ground,' and requiring that, even when firing over land, special consideration be given to the possible harmful effect of any chemical other than the usual smokeless powder and projectile-bursting charge. A military guard for the purpose of frightening ducks away has been maintained constantly during the season when they are in the region, and in the spring of 1924 an automatic acetylene flash-gun, together with a 'scarecrow,' was placed in a boat moored over the celery bed. It has been suggested that the area be dredged out, but the expense involved has so far prevented such action.

In time, the remaining bits of phosphorus may be so deeply buried in silt as to be inaccessible to the

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ducks, but in April of 1928 reports were made to the Chief Game Warden of Maryland that a large number of ducks had recently died in that region. Upon investigation it was found that the military guard had been withdrawn under the impression that the birds had left for the season. When the facts were brought to the attention of the Commanding Officer, the guard was restored at once. It will be seen that nearly three thousand pounds of phosphorus were shot over the area, and while undoubtedly much of it was consumed before striking the water, there remained enough to make this celery bed a source of much danger to wild-fowl for many years to come. This fact will be emphasized when it is remembered that, when under water, phosphorus is practically indestructible.

This case should prove an object lesson of the greatest importance to the end that sportsmen and conservationists will be constantly on guard to see that regions resorted to by wild-fowl are not contaminated by any materials that are likely to be deleterious to their welfare.

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As a rule birds have a marked resistance to all pyogenic (pus-producing) germs, which explains the many complete recoveries effected by birds from injuries that would have been fatal to mammals or fishes. Also, it should be borne in mind that very few of the diseases contracted by birds while in a state of nature are understood, and, as has been stated, it is rare for an ailing bird to come to the attention of a specialist competent to investigate (if not to treat)



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the malady. Some waterfowl areas appear to produce something — germ, poison, or parasite — that from present knowledge cannot be explained. For example, in the vicinity of Spring Lake Beach, New Jersey, a varying number of sick ducks will be noted from year to year, and while the logical assumption might be lead poisoning, the exact causative agent is not yet known.

*Aspergillosis.* — Aspergillosis, or mycosis of the air passages, is an occasional disease of poultry, and in adult fowls it is sometimes the cause of the condition known to poultrymen and pigeon-fanciers as 'going light.' It is known also as Pneumomycosis and is caused by an *Aspergillus*, a very common fungus, the spores of which are widely distributed in nature. So far as known the disease is fatal, usually within a few days, death resulting from toxæmia, exhaustion, or occasionally from asphyxiation. As with many other avian diseases it is difficult to diagnose, as some of the general symptoms agree closely with those of maladies that are in no way related. There is, however, a pronounced loss of appetite accompanied by an excessive thirst. The affected bird soon becomes inactive, and there is an increase in the rate of respiration and a rise in the body temperature. The mucus which collects in the trachea and bronchi frequently causes a rattling sound and the breathing is noticeably labored. The bird becomes severely emaciated and frequently develops lameness. *Post-mortem* examination of the vital organs shows the liver to be speckled or marbled with minute whitish or grayish-white mould colonies; cheesy nodules are present in the lungs, which, with the windpipe, will also contain yellow membranous patches. In heavy infections, the intestines, kidneys,

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peritoneum, and sometimes the heart, will be involved.

The prevalence of this disease among wild-fowl is not definitely known, but it is believed that the majority of the ducks that die from what is generally reported as tuberculosis have in reality succumbed to aspergillosis. Only two cases have come to our notice that apparently can be definitely attributed to this malady.

In October, 1917, many dead ducks were reported from Crane Lake, on the Illinois River, in the west-central part of the State. This is a region of intensive hunting, and it was at first thought that lead poisoning was the lethal agent. A few specimens were, however, sent in to the laboratory of the Biological Survey, where it was found that death had been caused by aspergillosis.

Another outbreak of duck disease, which it is believed was aspergillosis, occurred about 1875 among Scoters (sp.) which apparently died in considerable numbers on Burlington Bay, Lake Ontario. Only the one species was affected which may be an indication that the different varieties of this fungus do not thrive in all kinds of waterfowl. According to the report, the waters in the vicinity were not in any way polluted, nor did the birds respond to the treatment that would be expected were the trouble caused by alkali.

This disease has also been detected in Pintails in some of the great Western areas where waterfowl mortality is heavy from other causes.

Aspergillosis has been occasionally observed in ducks held in captivity. Mortality from it was rather heavy among wild Pintails at a game farm in California, according to a report by Dr. H. Van Roekel, published in 'California Fish and Game' for September-October,

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1929. In this case mortality with certain birds was due to secondary infection with bacteria.

*Tuberculosis.* — Avian tuberculosis (caused by a minute germ, *Mycobacterium tuberculosis avium*) is primarily a disease of the abdominal viscera, infection of the lungs being of comparatively rare occurrence in birds. The organs in birds that are most affected are the liver, spleen, and intestinal tract. Because of the fact that with most persons tuberculosis means pulmonary tuberculosis, it is believed that most of the reports of this disease in waterfowl have been unrecognized cases of aspergillosis, which usually produces whitish or greenish-yellow patches on the mucous lining of the air passages.

In diagnosing a case of tuberculosis, the liver and spleen are the two organs on which reliance may be placed. If positive for this disease, the liver will be covered with numerous raised nodules, which, when the organ is cut across, will be found to be distributed throughout the tissue. It is practically impossible to diagnose avian tuberculosis from external conditions and symptoms, but an advanced case does exhibit extreme emaciation, anæmia, general weakness, and sometimes diarrhea. These are likely to be combined with an unusual brightness of the eye and a ravenous appetite. As will be noted, some or all of these conditions are likely to be noted also in birds that have been poisoned by alkali or lead. Tuberculosis is not known to be a common disease of waterfowl, but Dr. Wetmore states that he has known cases involving the White Pelican and the Wilson's Phalarope.

*Other diseases.* — As we have intimated under 'Alkali Poisoning,' bacteria may be a contributory

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factor in some of the outbreaks of disease that at present are so puzzling to the investigator. It is worthy of note that in the early days of the 'duck sickness' at Salt Lake, specimens sent in and examined in the laboratory of the United States Bureau of Animal Industry were found to contain in the intestinal tract immense numbers of coccidia in various stages of development, and it was accordingly thought that *intestinal coccidiosis* was responsible for the mortality. Acting upon this diagnosis, the grounds of the New State Gun Club, where the birds were collected, were (in the following year) drained and allowed to bake in the sun for the purpose of killing the protozoa, but this treatment was unavailing, as there was a serious recurrence of the disease in late summer of that year. Intestinal coccidiosis also was thought by one specialist to be the trouble with the birds that died at Lake Johnstone, Saskatchewan, in the summers of 1920 and 1921, while another referred to septicæmia (*Pasteurellosis anserina*) as the source of the trouble.

Again, the mortality that occurred at the Cheyenne Bottoms, Kansas, in the winter of 1915-16 was thought to be due to a bacterial infection, while laboratory examination revealed a heavy infection with coccidia of young Mallards that died at a duck club in California. In the latter case, the eyes were seriously affected, there being acute inflammation with marked secretion.

One other case that has come to our attention may possibly represent a bacterial disorder. A report from Albuquerque, New Mexico, in January, 1921, stated that some tame ducks which had associated with wild birds contracted a disease with fatal effects. If cor-



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rectly observed and reported, it would seem that intestinal coccidiosis may have been the causative agency.

This disease, which is really a form of the malady known among poultrymen as 'white diarrhea,' is highly infectious. It is chiefly noted in young chicks, where it is generally fatal. The most conclusive method of diagnosis is by microscopic examination of fecal or intestinal matter, but excessive whitish or blood-stained droppings are at least suggestive of the disease.

*Fowl cholera*, although frequently reported as responsible for waterfowl mortality, does not appear to be a serious causative agency. We do not have a single well-authenticated case of its occurrence among wild North American waterfowl. It should be watched for, however, as it is a virulent, usually fatal, and highly infectious disease. It is caused by a minute bacterium known as (*Pasteurella avicida*), and is pathogenic for all kinds of domestic poultry and probably for all kinds of wild-birds. Dogs and cats are able to eat birds dead from this disease without seeming to experience any inconvenience, but birds suspected of having fowl cholera should not be used for human food. Possibly the best indication of this disease (aside from actual bacteriological or *post-mortem* examination) is the color of the excrement. In the droppings of affected birds, the urates or excretions of the kidneys will be a yellow color, which in health would be white. This is not positive indication of cholera, but it does indicate the possible presence of this disease. *Post-mortem* examination of a choleraic bird will show high inflammation of the kidneys,

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digestive tract, and mesentery. Frequently the liver will be marked by whitish areas, and sectioning will show that these are present throughout the tissue. No certain cure is known.

*Pneumonia*.— This is not a common cause of mortality among waterfowl, although sometimes birds reared in captivity will die from this disease. It also occurs occasionally with birds in a state of nature.

In September, 1920, many Mallards, Teal, Shovelers, and others were reported as dying in the vicinity of Burley, Idaho, on a small slough that covered about one acre. The dead birds were found to be fat and in good condition, and while the slough waters were brackish, it was not believed that alkali was responsible. Seven carcasses were sent in to the United States Bureau of Animal Industry for laboratory examination. Pneumonia was found to be the cause of death, an opinion in which a specialist of the Biological Survey concurred, as the birds showed none of the characteristic lesions either of lead or alkali poisoning. The disease probably was induced by unusual climatic conditions and is somewhat remarkable in that so many birds succumbed to it in such a limited time and area.

Pneumonia in birds begins, as in man, with a severe congestion of the lungs. There is likely to be a thick and often bloody mucus discharge from the nostrils and mouth and manifestations of labored breathing. The blood vessels that make up the vascular portion of the lungs become greatly distended and a serous fluid escapes through their walls, becoming the basis of an exudative accumulation in the air spaces. The lungs

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of a healthy bird are found upon autopsy to be of a bright red or pinkish color, and will float readily in water, but the lungs of a pneumonic bird are of a dark red or brownish color, and will sink when dropped into water. So far as is known, the disease is fatal usually within a few hours after its contraction.

### PARASITES

Probably all forms of life have other lower forms that are parasitic upon them. The descending scale seems to have no limit, but as a general rule neither external nor internal parasites of vertebrates are in themselves seriously pathogenic unless under unusual circumstances they become abnormally abundant and so exhaust their host. Frequently at *post-mortem* examination of a heavily parasitized animal it is found that death has been due primarily to a bacterial infection, which gained its foothold because of the weakened condition brought about by the parasites.

External parasites of birds represent four groups of insects, two belonging to the *Diptera* or flies, one to the *Hemiptera* or true bugs, while the other is the order *Mallophaga* or bird lice. Internal parasites include nematodes or round worms, trematodes or flukes, cestodes or tapeworms, and the unicellular organisms known as *Protozoa*.

Duck lice are familiar to every sportsman, as these flat, semi-transparent insects will leave the body of their host after its death and frequently are annoying when they crawl onto the hands and arms of the shooter as he inspects his game. The discomfort is temporary, however, as they will not live on any animal other than their natural host. From four to six species are known

## POISONS, DISEASES, PARASITES

from ducks. They have biting mouth parts and feed on feathers, epidermal scales, or body excretions. So far as is known, they have no bad effects when present in limited numbers.

The hippoboscids or louse flies seem to be of rare occurrence on ducks and geese, and we know of no case where any of these external parasites have been the cause of waterfowl mortality. Any parasitic, biting insect may, however, be the means of transmitting germ diseases that might be prevalent, so their possible significance should not be overlooked.

Ducks are afflicted with great numbers of internal parasites, but their exact relationship to the welfare of the hosts is not clearly known. Probably this is best illustrated by the results of examinations made at the laboratory at Klamath Falls, Oregon, during August, 1929, by Dr. Eloise B. Cram, of the Zoölogical Division, Bureau of Animal Industry, working in collaboration with E. R. Kalmbach, of the Biological Survey. This study was made to discover if there was any correlation between parasitic infestation and the 'duck sickness.' Many *post-mortem* studies were made of sick ducks, gulls, and shore birds, and, while parasites were found to be present in a high percentage of birds examined and often in heavy infestations, control — that is, birds presumed to be normal — also showed parasites. A few sick birds showed no parasites, although exhibiting the same symptoms as those that were parasitized. The parasites found represented a wide variety of species with no indications of a predominance of one species occurring throughout the different birds, and Dr. Cram's conclusion was that the evidence appeared to rule out the possibility that



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parasitic infestation was in any way correlated with the 'duck sickness.'

The parasites found were round worms, flukes, tapeworms, and *Protozoa*. The infested parts were chiefly the digestive tract, but also the trachea and the body cavity near the heart. In some California Gulls, tapeworms sometimes were present in enormous numbers in the small intestine, and flukes were found in a variety of locations from the mouth to the cloaca. Mallards had tapeworms in their intestines; at least four species of round worms in the upper part of the digestive tract; flukes in the bronchi, small intestine, and rectum; and *Protozoa* in the rectum. Cinnamon Teal showed round worms in the glandular and muscular stomachs, flukes in the large intestine, and tapeworms on the posterior end of the intestine at the vent. Curiously enough, no parasites were found in Redheads, although it seems not improbable that more material for study would have revealed some in this species. Some pathological conditions were found associated with the parasites, even though they could not be definitely connected with the 'duck sickness.' For example, a hemorrhagic necrosis of the corneous lining of the gizzard in California Gulls, Coots, and Cinnamon Teal was found associated with a species of round worm, while another nematode, a species of *Echinuria*, formed tumors at the junction of the glandular and muscular stomachs.

Nematodes are probably the most numerous of all internal parasites of waterfowl. They represent a great number of species and run in size from 9 millimeters to 130 millimeters in length. The female is always the largest, sometimes many times the size of

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her mate. The color varies from white or yellowish-white to red. As we have indicated above, they are to be found chiefly in the alimentary canal, the small intestine and cæcum, or blind gut, being frequent points of infestation. They also are found in the trachea, bronchi, lungs, air sacs, eggs, and oviduct.

Infection is sometimes direct, the eggs passing out in the feces of the infected birds, and developing, usually without hatching, to a stage where they will infect other birds when swallowed. With other species an intermediate or secondary host enters the picture, a common one being the small crustaceans known as 'water fleas' (*Daphnia pulex*), or 'sand fleas' (*Gammarus pulex*). In such cases the eggs pass out of the infected birds in its feces and are swallowed by the fleas, where they hatch and the young worms make their way to the body cavity, there developing as infective larvæ. Then the 'fleas' are eaten by birds, the worm develops to maturity in its primary host, and the cycle is completed. With some bird nematodes, such as the species of *Eustrongylides*, which are found adult in Mergansers and other fish-eating birds, it seems likely that fishes are intermediate hosts. The common earthworm may serve as a mechanical carrier of another group of intestinal round worms, the *Ascaridia*, and also of tapeworms; in these cases, however, there is no development of the parasite in the earthworm, the latter merely serving as a reservoir.

In connection with this reference to secondary hosts, it is of interest to note that Professor L. B. Becking, of the Jacques Laboratory at the Hopkins Marine Station, Pacific Grove, California, has reported

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that the brine shrimp, *Artemia salina*, which is enormously abundant in the waters of Great Salt Lake, often contains the encysted larva of a tapeworm. As there are no fishes in Great Salt Lake, Professor Becking concluded that some common water bird would be found to harbor the adult parasite. Upon mentioning this to Dr. Wetmore, he immediately stated his opinion that the Avocet was probably this host, as he had found that these birds in the Bear River Marshes were almost invariably infested with tapeworms, and the brine shrimp is known to be one of their principal items of food.

Among the protozoans there are at least two varieties of *Sarcocystis* that are very common, and are probably familiar to many sportsmen. The chief sites of infestation are the wing and breast muscles, and we have seen ducks, which when skinned were literally covered with what appeared to be short streaks of yellow fat. Upon sectioning a muscle, it is found that these sarcocysts are found not only at the surface, but also throughout the tissue. The disease is frequently referred to as 'measles,' and while the ultimate effect of a heavy infestation upon the host is not clearly understood, there would seem to be a strong probability that it may be serious. The method of transfer from one host to another is not known. Thorough cooking will eliminate any possible danger of human infection, although it is not believed that these organisms would be transmitted through eating the flesh of the infested host.

Only a few cases are on record of parasitic infestation that may have been the direct cause of death. In December, 1928, Mr. J. Stokley Ligon, of the New

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Mexico Department of Fish and Game, sent in to the Bureau of Animal Industry, a Shoveler that he reported to be one of about three thousand that had died during the preceding three months on Elephant Butte Reservoir. The bird was greatly emaciated and did not have the customary signs of alkali poisoning. Upon dissection it was found to be harboring an unusually varied collection of parasites, consisting of round worms, tapeworms, and flukes. Among the round worms was a severe infestation of the gizzard with what appeared to be the larval form of an *Acanthocephalid*, resulting in a hemorrhagic necrotic condition of the lining. Secondly, the specimen had its intestine infested with an enormous number of very small tapeworms. Although from an examination of this single bird, it is not possible to state that they presented the cause for a heavy mortality, the tapeworms must nevertheless be viewed with considerable suspicion. On the specimen examined they would be ascribed as the apparent or probable cause of death, particularly since, in poultry and upland game birds, tapeworm disease is usually accompanied by the extreme emaciation that was noted in this specimen.

Two Lesser Scaup ducks sent in to the Bureau of Animal Industry in March, 1925, from the lower part of the Potomac River, were found to have their intestines filled with tapeworms, identified as a species of *Timbriaria*. These are not supposed to be pathogenic. Cultures were obtained from several organs of these birds and it was found that bacteria of the *Bacillus coli* and *Streptococcus* varieties predominated. Again in October, 1928, two other Lesser Scaups were sent in from this same general region, but these were



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found to be infested with a trematode parasite. These flukes had caused a very severe inflammation of the intestine and 'apparently' caused death.

A Whistling Swan from Currituck Sound, North Carolina, was found to have an abundant supply of intestinal flukes of the family *Echinostomidæ*. The catarrhal inflammation of the bird's intestine might easily have been due to the flukes, and while, as a general rule, this pathological condition would not of itself account for the death of the bird, it may have been a predisposing cause and in connection with some unknown factor have been responsible for death.

Many heavily parasitized ducks have been reported from Louisiana, and there seems little doubt that in many cases round worms have been an important contributing factor in the waterfowl mortality in that State. A delicate threadlike worm has been found embedded in large numbers in the walls of the esophagus of ducks that died in the great coastal marshes of this State, particularly in the region south of Gueydan, Vermilion Parish. Pintails seem to be the species chiefly affected, but the parasites were found in a few Mallards. This worm is an Old-World species and is known to have caused outbreaks of disease among pheasants and waterfowl in Europe. Reports from foreign specialists indicate that it causes a mechanical inertia with paralysis of the walls of the esophagus, including the crop. The resulting distention of these parts may ultimately compress the pneumogastric nerve and cause a fatal asphyxia. In commenting on the Louisiana case, specialists of the Bureau of Animal Industry were unwilling to state that these worms were the actual cause of death, but it was significant that no

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other pathological conditions were found in the specimens examined in the laboratory.

A young Mallard from the Sully's Hill Game Preserve in North Dakota was found to be infested with parasites known as thorn-headed worms (*Corynosoma*), but it is not believed that they caused the death of the bird. An Old Squaw duck sent in from Alaska in 1928 harbored a species of tapeworm of the genus *Mesocestoides*, which is of interest chiefly because it had never before been detected in this host. Previously this parasite had been known from the European Skylark, an Egyptian shore bird, the Golden Eagle, Western Grebe, and the American Merganser.

*Other causes of waterfowl mortality.* — Surprising though it may be, ducks will sometimes die in large numbers from *starvation*. In February, 1929, many Mallards died in western Montana and northern Idaho. The winter had been open up to this time with abundant food available, causing large flocks of birds to remain in the region. A rapid freeze-up with heavy snow suddenly cut off the food-supply, and while a day's flight would have taken the ducks to open water and food, for some reason they did not leave, and consequently many of them starved to death. In one small area, three boys counted seventy dead ducks along a drainage ditch, and many persons reported gathering up and caring for birds so weak from lack of food that they were unable to fly. Some observers reported that 'thousands' of ducks were either starved or frozen in this region.

A somewhat similar case was noted in press reports from Buffalo Lake, near Camrose, Alberta, in February, 1924. When the ducks arrived, the weather was

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mild with food abundant. A heavy fall of snow cut this off, and only by united efforts were the birds able to keep open small areas of water. They were observed to gather and feed with prairie chickens around straw stacks, which provided a small amount of food in the form of waste grain.

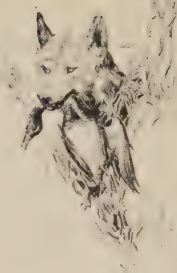
Many other instances have been reported; even such concentration points as the great ducking marshes of Arkansas and Louisiana are sometimes afflicted with a dearth of food for ducks, indicating in no uncertain manner the work that must be done by sportsmen and conservationists in providing for the needs of these birds. There should be, however, constant vigilance to guard against the reports that are sometimes received from certain classes of farmers to the effect that, because of a failure of the natural food-supply, the waterfowl have descended upon and are destroying their crops. Such reports are, of course, coupled with a request for a permit to shoot or a claim for damages. While it must be admitted that these depredations upon crops intended for human consumption have occurred in the past and are likely to continue, there also is a very strong probability that sometimes the complaining farmer had such a poor crop that he did not try to harvest it, and it became valuable only when he conceived the idea that he might be able to collect damages from the State. All such cases should receive the most careful and impartial investigation before any action is taken against the wild-fowl. Frequently it is possible to drive the birds from the fields without having recourse to shotguns.

Occasionally waterfowl are the victims of curious accidents. Whistling Swans resting on the Niagara

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River have been caught in the current and carried to their death over the falls. In 1912, it was estimated that two hundred of these fine birds were destroyed by this natural trap. Another unusual case of waterfowl destruction comes from Humboldt Bay, California. In December, 1923, and again in January, 1924, at least a thousand dead and crippled ducks were found on the sand spit at the north entrance to the Bay. According to eye-witnesses, the ducks would drift inshore while asleep, only to be overcome by the breakers and thrown violently on the beach. Those that were picked up still alive had broken legs, wings, or backs. The report was substantiated by the California Fish and Game Commission, and we understand that similar occurrences have been observed on the coast of Africa, near the mouth of the Niger River.





## CHAPTER IV

### NATURAL ENEMIES

IT is axiomatic that waterfowl have many natural enemies. When the country was in a state of primitive wilderness, the predators of water, land, and air, then much more abundant, were, with disease, the means of maintaining that exquisite balance that exists everywhere in Nature prior to the advent of civilized man.

Primitive people have always levied a heavy toll upon the flocks of wild-fowl, and certain tribes had ceremonial rites that were celebrated in connection with their duck and goose hunts. In North America, one of the early accounts of such a hunt has been described by Samuel Penhallow, the historian, who visited the Kennebec River country in Maine in 1717 for the purpose of treating with the Indians. While there he witnessed a hunt in which 4600 ducks were killed without the use of guns. To this day Eskimos and Indians of the North take birds for food in rela-

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tively large numbers. Sometimes the population of an entire tribe of Eskimos will participate and drive into net corrals the fully grown but unfledged young of geese and the adults rendered temporarily flightless through the moult of their wing feathers. To the Indians of the Great Plains and the Mississippi Valley, it is not likely that ducks were ever important, since in these regions larger and more profitable game also was abundant.

Dogs belonging to Indians and Eskimos are always poorly fed and in summer are forced to shift largely for themselves. At such times they frequently are the cause of heavy destruction on waterfowl breeding grounds. Dr. E. W. Nelson, former chief of the Biological Survey, tells us that forty or fifty years ago, when he was stationed at St. Michaels, Alaska, it was not an uncommon sight to see an Eskimo dog returning from a hunt on the tundra, with its fur matted and stuck tight to its head by the contents of eggs on which it had been feeding. In Labrador the natives use dogs in searching for nests of the Eider duck, this practice resulting in the destruction of many birds that are seized as they leave their nests.

We have no knowledge that disease — which in modern times has so decimated the flocks — was an important factor in controlling the surplus in early days, although epizootics, due to parasites, fungi, or bacteria, may have occurred. It would accordingly seem logical to conclude that predaceous mammals, birds, reptiles, and fishes were of first importance. We do not, of course, have any knowledge concerning the extent to which this control was effective, and even to-day it must be admitted that accurate data are

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lacking concerning destruction by predatory animals. Nevertheless, we may confidently assert that the idea prevalent in the minds of many sportsmen that hawks and owls are responsible for a heavy mortality among waterfowl is utterly fallacious. Of all bird-killing hawks, only one, the Duck Hawk or Peregrine Falcon (*Falco peregrinus anatum*) possesses flight superiority that enables it to overtake and capture even the slowest of the ducks, and these hawks are to-day so uncommon that it is doubtful if many sportsmen have ever seen one. And even so the Peregrine is such a magnificent bird, and possesses such perfect mastery of the air, that the spectacle of one in pursuit of a swift-flying teal or other duck should call forth the highest admiration of the observer, rather than a feeling of resentment coupled with a desire to kill the bird which is striving to do only that which the hunter himself has planned.

At this point it seems well to attempt a definition of the word 'vermin,' which to-day comes so easily to the lips of the average sportsman and conservationist. After a careful consideration of the matter, we believe that as generally used 'vermin' includes all animals that kill other animals that man himself desires to kill. In other words, by some distortion of his mental processes, man has relegated to himself the right to kill and denies this to all other creatures of the earth. We would not, of course, imply that there is no such thing as vermin, for the term seems particularly appropriate for the feral house cat and the brown rat, animals that have no natural place in the economy of the wild life of our continent, and for whose presence man is solely responsible. Also, we appreciate that upon

*Wood Duck*  
*female*

*Red-breasted Merganser*  
*male*

*Green-winged Teal*

*American Merganser*

*Blue-winged Teal*

*Hooded Merganser*









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game farms or reservations, devoted to the increase of certain species of game birds or mammals, the control of many species of predatory animals must be carried on by the proper authorities. But we do wish here to register our opposition to the senseless slaughter of hawks, owls, gulls, harmless snakes, and other species that only too frequently are killed on sight, merely because it is thought that they may at some time kill a duck or some other game bird. With this somewhat lengthy introduction to the subject, which it is hoped will help to instill a spirit of broad-mindedness into the minds of our fellow sportsmen, we will consider the various forms of life that are more or less predatory upon migratory waterfowl.

*Mammals.* — The furred enemies of waterfowl include all carnivorous species that are associated with them in the same or adjoining habitats. These are coyotes, foxes, raccoons, skunks, minks, rats, possibly at times opossums, and occasionally weasels.

During recent years the coyote has been extending its range northward so that they now occur commonly in some of the great wild-fowl breeding grounds in northwestern Canada, and in considerable portions of Alaska. So prevalent have they become in certain sections of Alaska Territory, including parts of the Upper Yukon and Tanana Valleys, that expert hunters from the Biological Survey have been detailed to study the problem of bringing them under control. The destructiveness of these predators is well known, so there can be little doubt that they may do much damage to the ducks and geese that use these important breeding grounds. This statement applies also in a limited degree to the Arctic fox during the years of its



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cyclical abundance when they probably exact more or less heavy toll from the breeding birds of the great tundras.

The other mammals mentioned cannot be considered as serious factors except possibly the brown rat, for the reason that they are mostly small, and thus feed chiefly upon smaller forms of life or other foods. Some, such as the raccoon, are practically omnivorous, and probably the only waterfowl that they ever eat are crippled birds that have fallen before the guns of hunters. All of them may on occasion attack and kill mature ducks and geese, but authentic records are so few as to be entirely negligible. Moreover, it should be borne in mind that they are all — together with the Arctic fox and to some extent the coyote — valuable as fur-bearers, so that control of their numbers is maintained by trappers who are seeking furs for the market.

We have mentioned the destructive operations of hunting dogs, but it is appropriate here to refer also to that scourge of all feathered life, the so-called 'domestic' cat, that can and does kill a great many wild-fowl. We have definite records of the destruction of adult Mallards, and in some areas feral house cats have so far outgrown what is considered their chief aversion as to become almost amphibious, taking readily to the water and swimming easily and well. The guns of sportsmen should be unhesitatingly turned upon any cats found hunting in woods or marshes. Ammunition so expended is for the preservation of native life of many kinds. Trapping, however, is the only assured method of dealing with the feral cat.

*Birds.* — As we have indicated in the introductory paragraphs to this chapter, the evidence available does

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not show that the true rapacious birds, the hawks and owls, are important factors in the destruction of waterfowl.

The Bald Eagle is frequently accused of the destruction of ducks and geese, and it is true that, after fish, birds make up the most important item in its diet. We know, however, that in many ways its food habits are comparable to those of the vultures, and that it will gorge itself to repletion upon carrion rather than attempt the capture of living prey. Observations of many individuals indicate that these birds have come to recognize the opportunities for food of this nature that exist in ducking marshes, where, by maintaining a close espionage upon the activities of the wild-fowler, they are able to obtain dead or crippled ducks and geese. At times they undoubtedly capture these birds without human aid, but such occasions do not seem to be numerous.

The Gyrfalcons of the Arctic regions prey to some extent upon Eider ducks and other sea-fowl, but it is not known that their activities affect in any way the species of ducks that are important as game. The powerful Goshawk of the North, which in some winters comes south in large numbers, will sometimes capture waterfowl, but being chiefly a bird of the woods, upland game birds make up the great bulk of its victims.

The common Marsh Hawk, which is readily identified by the conspicuous white rump patch, is, as its name indicates, a bird of the marsh land, where it may be observed beating back and forth a few feet above the grass or rushes. Although the principal item in their food is the meadow mouse, they can and do capture some small birds and occasionally waterfowl, especially

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young ducks. Here again, however, there is reason to believe that the adult ducks destroyed are usually crippled birds that have been lost by gunners, and such being the case they are entitled to the commendation of the sportsman as a means of putting out of the way these hopelessly wounded birds. We have no means of estimating the damage inflicted by Marsh Hawks on ducklings.

Among the owls the Great Horned Owl and the Snowy Owl are the only species that are known to prey habitually upon game birds. Fortunately, the latter species is confined to the Arctic regions, although it is a regular winter visitor to the Northern States. Sometimes, when there is a failure of the food-supply in the North, there will be a heavy invasion of these beautiful owls, which may penetrate southward to or beyond the fortieth parallel. Unquestionably some game birds are then destroyed, but a recent analysis of 284 stomachs collected in the Northeastern States shows that their toll of waterfowl is extremely small. Their main source of food consists of rats and other rodents. They seem successful only in killing tethered decoys and a few crippled ducks. Remains of Black Ducks were present in only four stomachs. On the great Arctic breeding grounds, when there is a shortage of the hares and lemmings that make up the bulk of their food, the case may be different. Birds of several species are then taken and, being both large and powerful, these owls have no difficulty in killing birds as large as a goose. Here, again, judgment should be withheld, as the evidence is not sufficient to warrant a general condemnation, and it should be remembered that they have always been an element of the native fauna, and are at least entitled to tolerance at the hands of sportsmen.

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The Great Horned Owl is chiefly a woodland species, but it is sometimes guilty of serious depredations around fenced ponds where ornamental ducks are kept, at game farms and at shooting clubs where live decoy ducks and geese are used. Under such circumstances the individual guilty owls should be destroyed, for once such easy living is discovered they will continue their nocturnal raids.

During recent years there has been some agitation calling for the control of the Glaucous-winged Gulls and Jaegers that prey to some extent upon the eggs and downy young of waterfowl upon the great tundra breeding grounds of the North. The evidence thus far available comes mostly from the delta of the Yukon River, and it appears that these birds do a certain amount of damage in that area. The solution to the problem is not apparent, for it will be obvious that the only suggested remedy, that of systematic shooting, would almost surely do more harm than good. Mr. O. J. Murie, of the Biological Survey, who from personal experience is thoroughly familiar with conditions in this region, has stated his belief that a control crew of either natives or white men, working during the waterfowl breeding season, would be responsible for a far greater loss among the game birds than is occasioned by the attacks of the predatory species, not to mention the unfortunate influence that such work would have on the natives, who are being gradually educated to conservation principles.

During comparatively recent years there has been a notable increase in the numbers of the common crow, particularly in those newly established agricultural districts in the prairie sections of western Canada. As



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great numbers of waterfowl breed in these regions, the potential damage that can be done by crows is obvious. Fortunately, however, this destruction is confined almost entirely to eggs and seems to be most serious with the early breeders. Ducks start breeding before the vegetation has acquired sufficient growth to afford adequate concealment for their nests, and it is these early nests that are quickly found and broken up by crows. If the first set is destroyed, ducks usually will lay again, and as the second set is apt to be better hidden by vegetation, the actual loss is not so great as would at first appear. Nevertheless, the depredations of these birds constitute a new and added menace to wild-fowl and their numbers should be rigidly controlled. Something has been done in Alberta by contests between shooting clubs, and in one year (1924) nearly fifty thousand crows were killed and reported in this one province.

*Reptiles.* — Among this class of animals the natural enemies of waterfowl are large snakes, snapping turtles, and (in the South) alligators. The extent of their depredations is problematical, but locally it may be relatively heavy.

Some of the larger colubrine snakes undoubtedly prey to some extent upon the eggs and young of any birds that are available, but fortunately large reptiles are confined to the warmer sections, and the great breeding grounds of the North are entirely free from their activities. Several years ago, while engaged in a study of the breeding waterfowl of the Barr Lakes region east of Denver, Colorado, the junior author noted the destruction of entire clutches of duck eggs by the common bullsnake (*Pituophis sayi*). On one oc-

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casion a three-foot snake was found coiled up in the nest of a Pintail, where it had just swallowed one of the eggs. Upon being disturbed, the egg was regurgitated unbroken. This egg, we might add, together with the remaining two in the nest, was subsequently hatched under a hen.

The large snapping turtle (*Chelydra*), that is found in many rivers, ponds, and marshes, from southern Canada to the Gulf of Mexico, and the still larger alligator snapper (*Macrochelys*) of the swamps from Florida to Texas, are both carnivorous. Sufficient investigation of their food habits has not yet been made to determine the extent to which feathered prey figures in their diet. But many observations indicate that these reptiles are probably important natural enemies of waterfowl, their most serious depredations being among the ducklings. As they rank among the largest and most powerful of fresh-water turtles, they are fully capable of dragging a full-grown duck below the surface.

In a bulletin prepared by Dr. Remington Kellogg, of the United States National Museum,<sup>1</sup> the food habits of the alligator are discussed at some length, based upon the laboratory examination of 149 stomachs of these reptiles, and on other information. In the stomachs of those examined, birds formed about five per cent of the total animal matter, while other information indicated that at times birds form a much heavier proportion of the alligator's year-long diet. A specimen killed at Green Pond, South Carolina, had the remains of five Mallards in its stomach, while ten others, taken during

<sup>1</sup> *The Habits and Economic Importance of Alligators*. Technical Bulletin 147, United States Department of Agriculture, December, 1929.

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February and March in Cameron Parish, Louisiana, had eaten a total of fifty-five coots, and six ducks. Others killed in this same area had eaten ducks, coots, rails, grebes, Least Bitterns, and owls. From this it would appear that, when alligators were abundant in the Southern marsh land, they were important natural enemies of wild-fowl, but, since they have been so heavily exploited for their skins, it is not believed that they are any longer a serious menace.

*Fishes.* — The voracious bass, both large and small-mouthed, is an undoubted natural enemy of waterfowl, although their depredations probably are confined entirely to young birds. A pond located on a game farm and stocked with bass is almost certain to be a total loss as a source of waterfowl production. Large specimens of pike, pickerel, and the different species of trout also take young ducks occasionally, but it is not known that such cases are numerous. We have no information indicating that the large alligator gar of the Southern canals and bayous captures living waterfowl, as the vertebrate part of its food appears to be composed chiefly of carrion.

It seems strange to think of eels as natural enemies of waterfowl, but in Wenham Lake, Massachusetts, the senior author has lost many decoy ducks from the attacks of these fish. These losses persisted for several seasons, until it became necessary to use eel traps in the areas where the ducks were tethered. The attacks ceased naturally when the eels left the shallow shore waters, usually about the first week in October. Whether eels can successfully attack wild waterfowl, we do not know. It seems scarcely possible that they can be quick enough to catch free-flying or uninjured ducks.



## CHAPTER V

### OIL POLLUTION

FROM the viewpoint of the welfare of our migratory and other waterfowl, pollution usually means — oil. Occasionally, it is true, other foreign matter introduced into a water area may be the direct cause of the death of ducks and other birds; also it is well known that many forms of pollution, such as refuse from rayon, paper, and sawmills, sulphurous water from mines, sewage, and other industrial and civic wastes, are frequently responsible for the destruction of enormous quantities of fish, shellfish, and other aquatic life. There is no question of the serious nature of such contamination, but as our subject is limited to waterfowl, pollution by oil so far overshadows all other kinds of pollution as to relegate them to places of minor importance.

In addition to the effect upon aquatic life, the problem is of great interest and importance because of the pollution of bathing-beaches, harbors, and shore pro-



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perty, resulting in interference with healthful water and shore recreation; besides an increase in the fire hazard. In 1926, the Interdepartmental Committee on Oil Pollution of Navigable Waters reported to the Secretary of State that: 'The principal injuries occasioned by pollution were fire hazard, damage to marine and shore property, destruction of waterfowl, and injury to the fisheries. The National Board of Fire Underwriters had found that oil pollution constituted in certain harbors a "serious fire menace." Oil pollution disfigured the paint on boats, damaged clothing, and fouled bathing-beaches. Reports of the destruction of waterfowl were widespread. Circumstantial evidence went to show that, where oil pollution exists, fish disappear, and that such pollution was detrimental in other ways to marine life.'

Ranking with our world-famous parks as an important aid to human welfare are our coasts and lake shores, river-banks, and smaller streams. In fact, to base the comparison entirely upon the percentage of the population that is benefited thereby, aquatic resorts are unquestionably second to none. Literally millions of persons gather each year at watering-places for bathing and other water sports, while the streams of the country are a part of the rightful heritage of the great fraternity of anglers. Under no pretense can they be considered as legitimate dumps for the waste from industrial plants and from cities.

The effects upon beaches of high value for recreational purposes which have been fouled by oily or tarry deposits with a serious depreciation in the value of property, have been particularly noticeable on the shores of Long Island and New Jersey within a radius

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of fifty or sixty miles from the entrance to New York Bay; near the capes of Chesapeake Bay; and on the coasts of Florida, Texas, and California; but such results are by no means confined to these places, and may show up sporadically almost anywhere along the shore. Notable cases of destructive fires that have been caused or aggravated by petroleum films or deposits are those at the Canton Lumber Company, at Baltimore, Maryland, on December 3, 1919, and at the Jahncke Dry Dock and Repair Company, at New Orleans, on December 16, 1920. The press has reported other fires of similar nature or origin at other places, where a red-hot rivet accidentally thrown overboard during repairs or a carelessly discarded match or cigarette sufficed to set an entire harbor in a blaze.

The effect upon the fisheries and aquatic life other than waterfowl is in part circumstantial, since the mere presence of dead fish in an oil-polluted area is not proof of the causal relation. There are cases on record where fish have died in large numbers from undetermined causes where no oil pollution existed. It does, however, seem definitely established that oil may at times be responsible for killing or at least repelling fish from polluted waters; for the destruction of eggs or the surface-swimming fry and larvæ of fishes and shellfishes; for the destruction of spawning grounds and eggs through the precipitation on the bottom of heavy, tarry materials and oils; for the destruction of the plants and invertebrate animals that either directly or indirectly constitute the food of the economic species; and for imparting an objectionable odor or flavor to fishes or shellfishes, which make them unacceptable as food and therefore unsalable.

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The effects of oil pollutions on aquatic organisms are both chemical (toxic) and mechanical. Laboratory experiments have demonstrated that certain constituents of petroleum are quickly fatal to fishes in dilutions that may be as attenuated as four to sixteen parts per million. Some of the components which in very weak solutions do not quickly kill are nevertheless able to cause death in two or three days. It has been reported that during the World War the marine organisms in the aquarium at Sebastopol were killed on several occasions by water pumped from the harbor which had been polluted by oil from the Russian Black Sea fleet. Grayling, undergoing normal development in the State hatchery at Cold Spring Harbor, New York, all died immediately after crude oil appeared in the water-supply following heavy rains. Experiments in the laboratory have shown that a film of crude oil will kill the swimming larvæ of oysters and clams within an hour, and that a similar film, accompanied by agitation of the water to simulate wave action, causes adult oysters to become poor, sick, and unfit for food.

Farther on in this chapter we will give specific instances, showing the destruction of waterfowl that has been caused by oil, but it is proper at this point to describe fully just how these birds are affected by an oily deposit on the water. It has been found that, when birds alight on an oil-covered water surface, they soon find their feathers saturated with the oil and so are unable again to take flight. The fine down which insulates their bodies against cold and water becomes matted and water-soaked, the skin is exposed to the elements so that the birds perish from cold and hunger, while in some instances they are actually drowned. Live birds

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in this oil and water-soaked condition have been rescued, washed clean with soap and water, dried out, and liberated without suffering any apparent ill effects from the experience, but unless human aid is rendered, birds that alight in an oil-covered water area are almost certainly doomed to death.

Considering the origin of oil pollution it may be said that practically all agencies that are engaged in the production, transportation, handling, or use of oil must be considered as actual or potential sources of pollution of coastal and interior waters, as well as upon the high seas. Classified according to their relative importance there are (1) the marine sources, including seagoing oil-burning and oil-carrying vessels, and any other floating craft that use oil in any manner; and (2) the land sources, which include oil wells and fields, oil terminals or loading points, refineries, railroads, and a host of industrial plants of different kinds.

The constantly increasing use by vessels of fuel oil, with the resulting discharge by them of oil and oily mixtures, brings such ships (including oil cargo carriers) so prominently into the foreground that they are easily the most important direct cause of oil pollution near the coasts of maritime nations. A better understanding may be had of the possibilities, when it is known that, while in 1914, 501 vessels, using oil for propulsion, totaled only 1,721,747 gross tons, by 1925 the total number had increased to 3822 vessels, of 19,372,615 tons. These figures include only vessels of five hundred gross tons or over.

Oil tankers returning with salt-water ballast in their tanks and bunkers have been accustomed, upon approaching the three-mile limit, to pump out this ballast



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which by that time has become well mixed with the remaining oil in the tanks. Other oil-burning vessels follow similar practices, either in emptying fuel bunkers ballasted with sea-water or in pumping overboard bilge water and other wastes containing oil or oily mixtures. A report of the Shipping Board submitted December 18, 1925, concluded that annually 'possibly as much as 5500 tons of heavy oil are discharged in non-territorial waters, near New York Bay, from ballast water alone, and that 'a study of winds, tides, and currents indicates that possibly 17 per cent of this 5500 tons may be carried ashore.'

Previous to 1926 there was available no information that tended to show what becomes of the great quantities of oil that are pumped overboard from vessels at sea. In November and December of that year and in January, 1927, the Bureau of Standards of the Department of Commerce, with the assistance and coöperation of the Navy Department, conducted a series of experiments in Hawaiian waters and in the Atlantic Ocean just outside New York Harbor. As much as 110 barrels of oily mixture (70 per cent fuel oil and 30 per cent sea-water, mixed in a tank for several days prior to discharge) was pumped overboard at one time in these experiments. The resulting 'oil slick' was then marked with a buoy and kept under observation for several days. As a result of this work, it was concluded that: 'Dependent upon the kind and amount of oil discharged, the area into which it is discharged, the prevailing wind and currents, and the average surface condition of the sea,... oil-water mixtures commonly discharged from oil-burning and oil-cargo ships will film out to an invisible thickness within one hundred

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hours from the time of discharge into the sea.' In one experiment approximately seven thousand pounds of fuel oil was discharged, and within the period of observation it was estimated that this filmed out over an area possibly nine hundred square miles in extent, with a drift of about ninety miles. It was further estimated that the average weight of oil was 7.8 pounds per square mile. What further changes may take place remain unanswered, but it seems probable that further oxidation occurs and that evaporation and emulsification continues. What oil remains is in the form of a film of infinitesimal thickness, and it may become weighted down by atmospheric dust and salt until the combined specific gravity exceeds that of the sea-water and the last traces of the oil sink below the surface of the sea.

These experiments would seem to indicate that oil discharged on the high seas has but little menace to waterfowl, and that the chief danger to birds lies in oil pollution adjacent to coastal areas. Observation at many points substantiates this belief.

In responsibility for contamination with oil of territorial waters, other sources also must be considered. In such areas oil and tar pollution may originate in leakage from stills, pipe-lines, and filling-racks at refineries, waste oil from drydocks and ship-repair yards, and large public garages; direct leakage from oil wells which in some districts have been drilled out in the water; from the manufacture of water-gas; from coke by-product plants, coal-tar plants, chemical plants, railroad yards, power plants, and many other industrial plants. Railroad yards and roundhouses may be a prolific source of pollution where fuel oil is used by the locomotives, as is also the case with all industrial plants

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that use oil for the generation of power or for other purposes. Contamination from such sources is due usually to faulty procedure in the loading, storing, or use of oil, but there is also a most unfortunate tendency to discharge refuse matter into adjacent creeks, rivers, ponds, lakes, or marshes. Oil and tarry wastes introduced into streams may be (depending largely upon the distance from the source of pollution to the mouth of the stream) responsible for serious conditions in harbors, bays, and estuaries, although observation has shown that such matter when discharged into sluggish or very slow-moving streams, at points considerably above their outlets, tends to deposit along the shores. This in itself may be the cause of serious mortality among waterfowl feeding or breeding in marshes adjacent to the stream.

In the following paragraphs we will attempt to illustrate the destructive effects of oil upon waterfowl by citing cases that have occurred in coastal and interior waters. This information has been obtained from the reports of light-keepers, masters of lighthouse tenders, officials of State game departments, sportsmen's organizations, conservationists, and other observers, while many instances of the destruction of wild-fowl by oil are within the personal knowledge of the authors. About forty per cent of the lighthouse keepers that report oil pollution in the vicinity of their stations assert that ducks and other waterfowl are killed through its presence.

In 1921, a report from Gloucester, Massachusetts, stated that 'Loons, Murres, Icebirds [*sic*], Scoters, Black Ducks, Whistlers, Mergansers, and Geese were driven ashore dead in considerable numbers as a result



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of coming into contact with some kind of a crude oil which... gave them the appearance of having been dipped in coal tar.'

Early in January, 1922, a biologist of the Biological Survey found fifty-nine birds killed by oil in a three-mile stretch near Great Point Light in Massachusetts. These included American Eider ducks, White-winged Scoters, American Scoters, Murres, and Dovekies. In one protected spot he found ten oil-soaked Eiders in a beat of seventy yards. In this same period 'thousands of Eider ducks were reported as found killed by oil on the shores and beaches of Nantucket and Muskeget Islands.'

In March, 1922, a representative of the Biological Survey examined the ocean front from Nantasket Beach to Cohasset, Massachusetts, finding places where the entire beach was covered with a heavy black oil, with many hundreds of dead ducks and other sea-birds.

The United States Naval Atlantic Mine Forces operating in Ipswich Bay, Massachusetts, in September, 1922, were considered responsible for the killing by oil of many gulls, terns, scoters, and sandpipers. At Nantucket in January, 1923, one observer reported picking up fifteen ducks killed by oil, and he stated that many others both dead and dying had been reported to him.

A report from Boston, in December, 1923, of conditions at Monomoy is graphic: '... the number of poor birds we found down there covered with oil is perfectly awful, Coot [Scoters], Brant, Old Squaws, everything. The amount of oil varied from a little on the breast to so much they could not fly, but could only paddle about until they starved. Several had plucked themselves almost clean trying to get rid of the stuff.' In February,



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1924, 'hundreds of sea-fowl were reported as dead or dying as a result of contact with oil in the vicinity of Nantucket. Coots [Scoters], and Eiders seemed to be the ones chiefly affected, but also Old Squaws, some Loons, and other diving species.'

Early in the spring of 1928, the steamer Robert E. Lee went ashore off Manomet Point, near Plymouth, Massachusetts, and large quantities of fuel oil were consequently released. The result upon the migrating waterfowl was disastrous, as it was not long until the beach on the north side of Cape Cod was literally covered with dead and dying Black Ducks and others. One report stated that: 'Thousands of dead ducks were found strewn along the East Sandwich beach,' having been 'washed ashore by the strong easterly wind that has prevailed the past few days. The ducks were found on examination to be covered with a thick, tarry, or oily substance, which, in cases where it had not killed the bird outright, prevented its swimming or walking. A number of the ducks were still alive, but they could hardly move.'

A Massachusetts State fish and game warden, reporting in March, 1930, says: 'While I was at Nantucket on duty during January and February I counted hundreds of dead Coots [Scoters], Old Squaws, and Eider ducks killed by oil. In one day I counted 512 on Eel Point.'

On January 10, 1930, the steamer Edward Luckenback was wrecked on Block Island, Rhode Island. The oil released killed literally thousands of birds from this island and the adjacent shores of Long Island, to the mainland of Connecticut and Rhode Island. Seventeen species of birds were listed as killed by this oil.

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The Chairman of the Commissioners of Birds of Rhode Island has reported that about 1919 an oil tanker, while unloading her cargo at East Providence, broke the hose, and that pumping of oil continued for some time before the break was discovered. The oil covered the upper bay, and as an immediate result State officers gathered up and buried 494 Bluebills that were killed and which floated ashore.

In 1921, a United States deputy game warden reported that in Narragansett Bay he had gathered up and buried more than nine hundred ducks that had been killed by oil.

One of the most spectacular cases of coastal oil pollution occurred in the spring of 1924, when an oil tanker, the Llewellyn Howland, grounded on Sea Ledge off Newport, Rhode Island. Oil leaked from her damaged bulkheads and covered the surrounding water for miles. Fortunately, most of the migratory waterfowl had already passed on, and while several hundreds of ducks were killed, the damage was not nearly so serious as it would have been had the accident occurred a month earlier. Every tide washed more oil into the sea, and finally, when it was found that the wreck could not be salvaged, the owners, State officials, and the Federal Government coöperated and the torch was applied. A Providence newspaper of May 6, 1924, stated that 'Flames from the Llewellyn Howland, the oil tanker stranded on Sea Ledge, were mounting this morning into the air twenty-five feet, while clouds of black smoke attained a height of three hundred and four hundred feet. The sight presented by the burning tanker, particularly since the flames had spread all through her, has brought many visitors to the scene,

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and last night the flaming vessel made a weird picture from the shore. At times the oil that had leaked out and spread over the water took fire and the flames raced across the water, following the path of the floating oil, giving the thousands of spectators the idea of something akin to Dante's vision of the inferno.' The ship and cargo continued to burn for several days.

Observers and sportsmen frequenting the waters of Long Island Sound, adjacent to Connecticut, have reported great numbers of oil-killed ducks. In January, 1924, one observer reported that he felt safe in saying that the loss from this cause in that area must run into the thousands. One hunter stated that he could pick up twenty-five oil-soaked birds any day during the season.

Because of the large number of ships that arrive and depart from the port of New York, it is obvious that oil pollution in near-by waters must be exceptionally severe. This condition apparently reached a peak in 1924, in which year great numbers of oil-soaked birds were found in Long Island Sound. In 1921, many ducks were destroyed in a bay about two miles below Catskill, because of oil that leaked from a wooden storage tank installed by a cement company.

A report from Cape May, New Jersey, that was sent to the Biological Survey in March, 1922, listed Loons, Grebes, Scoters, and Black Ducks that had been killed in that area by contact with oil. Some other ducks that had been shot for food were unfit to eat, as their feathers had been pulled out in patches and the underlying skin had the appearance of having been burned. Also the flesh had the taste and odor of oil. In August, 1923, several ducks in this condition were found in the marshes of Overpeck Creek.



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Hunters from various parts of Chesapeake Bay reported in 1919 that many ducks were covered with a thick, gummy substance that proved to be oil which had been dumped into Curtis Bay by oil tankers belonging to a local corporation. During the winter of 1923-24, a pipe-line from an oil plant at Sparrows' Point broke, and, as a result of the escaped oil, one State game warden reported picking up forty dying Mallards, Canvas-backs, Redheads, and others. Attempts were made by various means to remove the oil from the ducks, but most of them died.

In January, 1922, an Old Squaw from Todd's Bay, Dorchester County, Maryland, was sent to the Biological Survey by the Honorable E. Lee LeCompte, the State Game Warden. It was completely covered with oil and tar, and an American Scoter in a similar condition was sent in from Chesapeake Bay by Mr. Swepson Earle, Chief Engineer (later Commissioner) of the State Conservation Commission. A Blackhead or Scaup duck, covered with tar and grease was found in South River in November, 1922. 'Acres' of floating oil had been observed there during the preceding summer.

The late Dr. B. H. Warren, who annually spent much time in observing the birds at Chincoteague, Virginia, reported in 1923 that he had seen several wild ducks oil-soaked and unable to fly, while reports from hunters in that region indicated that there was a very heavy mortality from this cause. Ducks killed for food were frequently not fit to eat because of their oil-soaked feathers. Several 'little Auks' (Dovekies) also were noted as killed by oil in this area.

Dr. L. C. Sanford, of New Haven, Connecticut, reporting in January, 1925, on birds killed by sportsmen



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in Pamlico Sound, North Carolina, stated that in the first three weeks of December (1924), he examined about four hundred ducks, geese, and Brant, finding sixteen so badly oil-soaked that they were unfit for use. The doctor comments: 'If anything like this percentage of injury could be applied to all the wild birds [i.e., those frequenting the polluted areas], the damage from oil must be appalling.' So far as observed, the species chiefly affected were geese, Brant, and Redheads, the latter two being the principal victims.

In August, 1922, a report was received from Charleston, South Carolina, to the effect that crude oil dumped into the Cooper River was having a serious effect upon 'marsh hens' (Clapper Rails) and Wood Ducks. A resident of Great Falls in February of that year found on Black River a large Loon that was so thickly coated with black, sticky oil that the bird was helpless.

A United States Game Protector reported in 1923 that while conducting investigations at Tybee Island, near Savannah, Georgia, he found eight or ten ducks that had gotten into some oil and had been washed ashore. The oil was so heavy that the birds could neither fly nor walk.

Several Loons found dead on the beach near Ocean City, Florida, in March, 1924, were covered with oil or tar. Examination showed that they were otherwise uninjured, and death had apparently resulted from starvation.

In the coastal regions of Louisiana and Texas, oil pollution can be particularly disastrous because of the heavy winter concentrations of waterfowl. The situation in this district is aggravated by the presence of oil fields which at times have been responsible for the

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contamination of large areas, and also by many sulphur mines which dump their refuse into the streams. Reports from this section show that in some instances small streams will be more or less covered with refuse oil, and while ducks that alight on them may be able to get ashore, the coating of oil that they receive makes it impossible for them to take flight again.

Large earthen tanks or reservoirs in the oil fields also may become veritable death traps. Generally these are kept covered, but not always. A large storage tank of this type at Humble, Texas, north of Houston, was several years ago struck by lightning and burned. The drain-pipes became clogged with charred wood and other débris so that it was virtually abandoned by the company. As a result it filled with water that was covered with a layer of heavy, viscous oil about five inches thick. In December, 1926, a United States Game Protector investigated conditions and estimated that there were five hundred dead ducks in the tank, with evidence of a great many more along the shore. In addition to ducks, he noted the bodies of Mourning Doves and Killdeers. Another similar tank at League City had the bodies of twenty or thirty ducks, and one near Boytown, Texas, about one hundred. Residents in the communities reported that these tanks were responsible for the annual death of 'thousands' of ducks.

As recently as April, 1929, reports were received of oil pollution at Port Arthur, Beaumont, Goose Creek, Houston, and Orange, Texas. The State has a pollution officer, but for one reason or another it appears that but little restraint is put on the offending companies.

On the Pacific Coast pollution from oil has been

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particularly severe in California waters. As far back as 1917, reports were received from the Farallon Islands showing the destruction by oil of thousands of Murres, Puffins, and Gulls, through the discharge of ballast and bilge water from oil tankers and vessels using oil as fuel, and under date of January 22, 1925, the keeper of the Farallon Light Station reported that during the previous week a large quantity of oil was noticeable on the water and that many birds were caught in it. He stated that the 'rocks and beaches are lined with wandering birds covered with crude oil. The number runs into the hundreds... all doomed to die of slow starvation.'

In 1921, large quantities of oil were discharged into San Pablo Bay at Vallejo, destroying duck food and the birds themselves. At times the backwaters of the Sacramento River were literally covered with oil.

Six Canvas-back (?) ducks were caught in San Francisco Bay in March, 1922, that were smeared with oil and unable to fly. These birds were in good health and they were released after the oil had been removed, but the report indicated that hundreds of others died from this cause.

On June 28, 1923, the 'Baltimore News' printed an article entitled 'Mysterious Pelican Deaths Laid to Oily Water.' In this it was stated that oil, covering the ocean along the southern California coast in the vicinity of Los Angeles, caused 'vast numbers' of Brown Pelicans to become oil-soaked, resulting in their destruction.

Fortunately, the California Fish and Game Commission has shown a commendable activity in efforts to stop such contamination of coastal and interior waters.



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In 1922, the chief engineer of a Shipping Board steamer was arrested and prosecuted for permitting the pumping of bilges while lying off the Navy coal bunkers at California City. He was fined two hundred dollars, which the operators of the ship forced him to pay, contending that he was solely responsible for acts of the engine-room force. As recently as 1928 the Commission won a notable victory when forty defendants were enjoined by the Superior Court of Los Angeles County from allowing petroleum to run into the ocean either directly or through natural drainage canals. This was in the Huntington Beach field, and several other companies escaped similar injunctions only by cleaning up their properties before the cases were heard. Pollution of the Ventura River resulted in another two hundred dollar fine for a corporation operating in the Ventura field. This same company had been indicted a year previous and given a suspended fine upon the assumption that the conditions for which it was responsible would be cleaned up. Upon the second offense, the judge insisted upon the payment of the fine, giving at the same time a scathing denunciation of such disregard of public welfare.

Puget Sound, Washington, was the scene of a heavy waterfowl mortality in December, 1924, when the U.S.S. Nevada was in drydock at Puget Sound Navy Yard. A United States Game Protector reported that a large quantity of oil was pumped overboard, with the result that several thousand Grebes, Scoters, and other birds were killed. This was a particularly serious case because the adjacent lakes and bays were frozen over, causing a heavy concentration of birds on the waters of the Sound. In February, 1925, oil discharged by boats



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near Port Townsend, also in Puget Sound, caused the death of great numbers of water birds. It developed that vessels in quarantine were pumping out fuel tanks and bilge water. This destruction was confirmed by the keeper of the light, public health officials, and owners of vessels at Port Townsend.

That pollution from oil is not limited to coastal waters is shown by many reports received from the interior of the country.

In Illinois a break in a pipe-line under the Illinois River at Chillicothe released what was estimated as 350,000 barrels of oil, destroying great numbers of ducks and coots. The Mosquito Abatement Association of Glencoe, Illinois, spread oil on the Skokie Marsh in the spring of 1925, and as a result, one observer picked up seven young Teal, eleven young Mallards, as well as Bitterns and Rails, all with their feathers plastered with oil. A refining company at Roxana, Illinois, has been reported to be running a swift stream three feet wide and two feet deep into Grassy Lake. This stream contains the refuse from the plant, with the result that the lake, which at one time was a noted waterfowl resort, is reported as covered with oil. A curious phase of this situation was that the offending company owned about ten acres of the lake where the ditch had its outlet, but the entire area, between two and three hundred acres, has been completely ruined as a home for any kind of wild life, and it is, in fact, a veritable death trap that has claimed the lives of great numbers of birds.

The Ouachita River in Arkansas has been reported as constantly covered with a film of oil discharged from refineries, and although press accounts of the resulting

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destruction of wild-fowl are believed to have been greatly exaggerated, it is nevertheless certain that many birds have been killed in this area.

A report received in April of 1922 was to the effect that the Big Horn River in Montana was seriously polluted by oil from a pipe-line company in the Thermopolis field, Wyoming. A beaver found dead in the river was believed to have been killed by the oil, while a farmer reported that his flock of tame geese came out of the river coated with oil.

In the Oklahoma fields it was found that owners and operators of oil wells had permitted large quantities of oil to accumulate around the wells, which was eventually carried off by heavy rains into near-by streams, resulting not only in the destruction of water-birds and aquatic vegetation, but also of cattle that came to the streams to drink.

According to press dispatches in 1920, oil operations in the vicinity of Reelfoot Lake, which is one of the most important waterfowl regions in the country, were responsible for considerable damage to birds. A river steamer flushing its fuel tanks in the vicinity of Memphis, Tennessee, was believed responsible for the destruction of many ducks.

A report received from Ogden, Utah, in February, 1920, stated that large numbers of ducks had died on lakes near Salt Lake City, as a result of oil on 'their necks and wings' that was obtained in diving for food in sloughs that carried waste from adjacent refineries.

Waste oil from the Union Pacific shops at Las Vegas, Nevada, was deposited in a pool of water, covering about five acres, and as a result, ninety-eight dead ducks were counted on one occasion. It is gratifying to

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record that when this condition was brought to the attention of the railroad officials, the nuisance was promptly eliminated through the installation of a separating plant to remove all oil from the wastes of the shop.

Under date of November 13, 1922, the 'New York Times' printed an account describing the destruction of thousands of ducks on Lake Tamiahua, about twelve miles south of Tampico, Mexico. According to the report this lake was covered in its entirety by a thick scum of heavy crude oil caused by wasting millions of barrels of oil from gushers running wild. For years this lake has been the winter home of thousands of waterfowl and it is easy to imagine the fate of these birds when, upon arriving again at their ancestral feeding grounds, they alighted in three or four inches of heavy asphaltum oil.

That the destruction of waterfowl by oil is not confined to American waters has been brought out by reports received from several European countries, notably England and Holland, where great numbers of oil-soaked birds have been found on the beaches. The worst pollution ever recorded was probably on the coast of Jutland after the naval battle of that name, when it was impossible to bathe on the beach without being covered from head to foot with black oily slime. This condition continued on that coast for several years.

In the Winter 1929 number of 'Bird Notes and News' (British), an observer writes of the terrible destruction of bird life on the coast of Wigtonshire in the spring of 1929, owing to the great quantities of oil washed up chiefly on the shores of Luce Bay. Scoters were wiped



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out by thousands, and in addition, divers, mergansers, cormorants, shags, guillemots, razorbills, gulls, terns, lapwings, plovers, oystercatchers, waterhens, and coots. A fisherman was reported to have killed a large number of ducks and geese that had been rendered helpless by the oil. The report stated that another such spring would entirely wipe out the shore- and sea-birds of the region.

The foregoing cases sufficiently illustrate the gravity of the situation and remedial measures are accordingly of interest and importance.

Many States have passed stringent anti-pollution laws, which if vigorously enforced will do much to rectify the deplorable conditions existing in vast areas of coast, river, and marsh. In 1927, the Legislature of Wisconsin passed a law charging the State Board of Health with the care and duty of enforcing all laws relating to the pollution of any waters of the State, whether such pollution affects public health, live stock, fish, or other aquatic life. California has been particularly active in combating pollution by oil, and the Fish and Game Commission has successfully prosecuted several cases against oil companies, steamships, and individuals. A law has been recently (1929) passed in this State prohibiting the drilling of any more oil wells on sea beaches, 'as a safeguard to health and cleanliness, and for protection to aquatic life.'

Early in 1917, the rapidly progressing menace of pollution from oil and oily mixtures was brought to the attention of Congress through the instrumentality of the Massachusetts Fish and Game Protective Association. This warning was not heeded, but in 1922 the Sixty-seventh Congress, by a Joint Resolution, author-



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ized and requested the President to call a conference of the maritime nations with a view to the adoption of effective means for the prevention of pollution of navigable waters. This resolution was referred by the President to the Secretary of State on July 1, 1922, and at his invitation the Secretary of Commerce suggested the desirability of a preliminary conference of the various departments interested. Accordingly representatives of the Treasury, War, Navy, Interior, Agriculture, and Commerce Departments, and the Shipping Board held a meeting on August 7, 1922, at which it was agreed that an interdepartmental committee should be formed for an exhaustive study of the problem so that the State Department would have adequate facts, constructive plans, and data upon the best possible means of combating oil pollution, for presentation at the proposed international conference. The committee was formed and its report, submitted to the Secretary of State under date of March 13, 1926, contained a detailed study of the sources and causes of oil pollution, the results of studies made by the Bureau of Mines, the Bureau of Standards, and other agencies on the effects and ultimate disposition of oil discharged into oceanic waters; steps taken by the Federal and State Governments and foreign nations to deal with the problem; preventive measures; and other related subjects. During the life of this committee increased activity was manifest on the part of sportsmen's and conservation organizations, prominent among which was the National Coast Anti-Pollution League. This association held a conference at Atlantic City, New Jersey, from October 1 to 3, 1923, at which there were about one hundred and fifty active participants, representing all

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Federal departments interested, the Canadian Government, oil and steamship companies, the fisheries industry, conservation departments and organizations, chambers of commerce, public health bureaus, fire underwriters, hotel and resort owners, yacht clubs, and others. In the work of this conference the American Petroleum Institute and several prominent oil companies united their efforts and worked out the details of a pollution bill to be drafted and introduced in the Sixty-Eighth Congress. This bill, introduced by Senator Willis, and known as the 'Oil Pollution Act, 1924,' was passed and signed by the President, on June 7, 1924. In brief it provides that 'it shall be unlawful for any person to discharge, or suffer, or permit the discharge of oil by any method, means, or manner, into or upon the coastal navigable waters of the United States from any vessel using oil as fuel for the generation of propulsion power, or any vessel carrying or having oil thereon in excess of that necessary for its lubricating requirements....' It provides further 'that violations upon conviction shall be punished by a fine not exceeding \$2500 nor less than \$500, or by imprisonment not exceeding one year nor less than 30 days, or by both such fine and imprisonment, for each offense.' The Secretary of War is charged with the enforcement of this law, which it would seem should do much to eliminate many of those instances of oil pollution that in the past have been disastrous to waterfowl in coastal areas.

In some districts the engineers have shown a commendable activity in checking up violations of this law and several noteworthy convictions have been obtained. Nevertheless, it will be obvious that it is not always

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possible to trace to its source every case of coastal oil pollution, which may not be noticed until several days have elapsed since the oil was discharged. In such cases it is difficult or impossible to obtain evidence sufficient to ensure a conviction. Also, at the present time (1930) there seems to be a tendency on the part of the engineers and other enforcement officers to minimize the damage or to give to the press statements that are misleading if not actually untrue.

The most important result of the extensive publicity directed against oil pollution was the Conference on Oil Pollution of Navigable Waters, held in Washington, D.C., June 8-16, 1926, and participated in by twelve foreign powers. At this conference it was brought out that, while 'there has been a marked diminution of oil pollution since attention was first called to it, due both to the action of the governments and to the voluntary coöperation of the interests concerned,' nevertheless, 'the evil is still serious in some waters and that it can only be dealt with satisfactorily by international action.' After a thorough discussion and consideration of all parts of the subject, the draft of a convention was adopted that provided for the establishment by the respective governments of areas in waters adjacent to their coasts, in which discharge of oil or oily mixtures from vessels (other than war vessels, separately provided for) shall be prohibited. At the time of writing (1930) this convention has been tentatively agreed to by nine of the powers represented at the Washington conference. It is likely that, if any of the three remaining powers will agree to the terms of the covenant, arrangements will be made for another international conference to be attended by representa-

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tives of the countries with the power to sign a treaty that will regulate the discharge of oil upon the high seas.

There remain for consideration the interior bodies of water that are polluted with oil from wells, refineries, loading-racks, garages, sewers, and industrial plants. These must receive attention from State Governments and municipalities, and, as we have pointed out above, several States have already taken definite action to clean up the unsatisfactory conditions that exist within their jurisdiction. Added to these, there are a great many local or municipal regulations controlling the pollution of coastal and inland waterways by oil, mainly for the purpose of reducing the fire hazard.

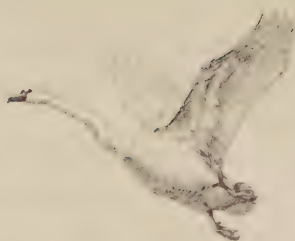
In conclusion it may be said that the danger to wild-fowl from oil pollution possibly has been somewhat lessened, but constant vigilance must be exercised so that still further improvements will be made and that there will be no recurrence of the heavily polluted waters that have already taken such heavy toll from the migratory waterfowl of America.





PART III  
CONSERVATION





## CHAPTER I

### CONSERVATION OF WATERFOWL IN GENERAL

SO MUCH might be said on this subject that we feel it is almost hopeless to condense our remarks into a short chapter. It is especially difficult to get a proper perspective just at this time because we appear to be passing through a rather troublesome transition period with regard to a future American game policy. The old order has been almost completely wiped out, and yet we have no long-range State or Federal program to take its place. Conservation interests are pulled hither and thither by local factions according to the most recent fashion in popular conservation nostrums. Few people have looked beyond a policy of continually increasing restrictions on the wild-fowler himself. Few people seem to realize that radical restrictions are merely instruments of temporary value and in the long run amount to nothing more than a public admission of failure to work out a practical game policy.



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Nevertheless, we have made some progress even if it is only in the nature of demonstrating the importance of factors other than shooting in striving to maintain wild-fowl balance.

Of course, in considering any long-range plan we must not forget for a moment that conservation will in the final analysis always have to contend with what is best economically for the average person in these United States. And this for the reason that only about five per cent of our citizens are interested directly in the outcome from the standpoint of sportsmen or nature-lovers. If we could imagine some startling discovery which suddenly made wild-ducks an economic necessity, there is no doubt that in five years we could have all the ducks we could possibly require. We could probably double or triple the present duck population of the United States and Canada in a very few years. But ducks would have to be worth a great deal more than they are to-day or probably ever will be. Their value now is chiefly as a recreational asset, and their food value of, let us say, \$5,000,000 or \$6,000,000 a year is almost negligible when compared to the meat production of all our farms, said to be worth the enormous sum of \$2,800,000,000. Nobody has as yet attempted to measure recreation in very exact terms, but we all know that its importance is recognized more from year to year.

The conservation of migratory waterfowl presents an entirely different problem from that of land game. Ducks, geese, and shore birds are able to tolerate great concentration, and, owing to their marvelous instincts, are capable of seeking out optimum conditions without any aid from man. This wonderful mobility of wild-

*Canvas-back*

*Blue-bill*

*Redhead*

*Ruddy Duck*

*Ring-necked Duck*









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fowl populations is of great importance, for it means that, theoretically at least, we can very easily map out an ideal geographical scheme to ensure their continuous welfare. As Mr. Aldo Leopold has pointed out, our knowledge of wild-fowl and their needs has far outstripped our methods of applying the remedies. With some other kinds of game the opposite might well be true.

The long fight for unified control began in the days of Charles Hallock (1897). At first it was an attempt to establish more uniformity in the laws among different groups of States. The effort finally culminated in the Federal Migratory Bird Act of 1913. Later these first attempts were consolidated and strengthened under the terms of the treaty with Great Britain and the resulting Treaty Act of 1918. Then followed ten more years of effort to translate the terms of that important treaty into visible acts, those acts which are to take form in restored sanctuaries for migratory wild-fowl.

The Norbeck-Andresen Bill was signed by President Coolidge in May, 1928. It provides for an eight-million-dollar program in the acquisition of suitable areas for inviolate sanctuaries extending over a period of ten years, followed by perpetual annual appropriations for the care and protection of the same. But unfortunately, this bill does not provide for any tax or license money levied upon the sportsman himself, which might be used for such necessary purposes as additional Federal game protectors, the regulation of public shooting areas, and the like.

At this time (1929-30) a Nation-wide survey of wild-fowl areas is being made by the Department of Agri-

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culture (United States Biological Survey) under the terms of the Norbeck-Andresen Bill, and the next few years will witness many interesting developments. In this connection it is very important that the proposed sanctuaries shall be located, as the result of sound biological knowledge, in regions where they will be of most service to the birds themselves and so become living monuments to stimulate State and private endeavor.

Owing to the great danger arising from concentration of aquatic birds on areas where water is failing, great care must be taken to secure a permanent supply of fresh water to avoid the possibility of alkali poisoning on a large scale, as described in our chapter on duck sickness (Part II, Chapter III). In cases where disease does appear on such reservations, some provision should be made to scatter the birds or temporarily drain off the polluted waters.

Many parts of the United States are of no real importance in maintaining our wild-fowl population, and such States or parts thereof should be rigidly excluded from the Federal sanctuary plan regardless of the very laudable desires of local interests. The funds available for this great demonstration are extremely small as compared to the needs of the case, and many factors will have to be taken into account before final choice of the different areas is made.

One drawback to this program is very evident. We have delayed so long in this restoration work that the Federal Government as a purchasing agent is put into direct and active competition with individuals and clubs for the acquisition of the few remaining choicest areas.

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When all is said and done, the most important function of the Government in this general plan of restoration of wild-fowl areas is an educational one. The results of the Federal survey of land and water areas, with its previous study of aquatic foods and the bird populations depending upon them, can be passed on to the interested States and used by them in building up their own programs of restoration. Such a plan fits in with a sound theory of government; namely, that in so far as possible the function of the Washington bureaus should be focused on demonstration and education rather than on the exercise of executive functions, where these last can be more harmoniously carried out by the States themselves.

We will probably always have in our midst groups of extremists, sometimes almost fanatics, who, themselves not sportsmen, seek to help the situation by penalizing and restricting the sportsman's activities in every possible way. The ideas of such groups find favor unfortunately among well-disposed persons who know nothing whatever about the diversity of the problems which have to be met in working out a sound plan of administration for our wild-fowl. These extremists argue that, if a little conservation in the form of added restrictions is a good thing, then a lot more radical restrictions will be even better. Every intelligent sportsman knows that additional restrictions can only be successfully applied up to a certain point, and this point must always consider the morale and good-will of the intelligent sportsmen. The extremists do not give enough consideration to this angle of the problem, and often they do not hesitate to suggest Federal restrictions that would not be



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respected and could never be enforced; would in fact endanger the whole fabric of Federal control.

Another danger lies in the fact that the extremists are apt to attempt to force through Congress regulations which the Biological Survey knows are not practical, the kind of regulations that would much better be considered in the legislatures of the several States and moulded to fit local or temporary conditions. There is, we think, grave danger in dividing the responsibility for administration of our migratory birds between Congress and the constituted Federal agency. Sportsmen should resist every effort which tends to bring about such an unfortunate situation.

We now have in the Bureau of Biological Survey a clearing-house for the exchange of ideas which is very valuable in gradually building up among all interested groups or persons a broader conception of the wild-fowl problem from a National angle. Sportsmen, on the whole, are inclined to very narrow views on the subject of migratory game birds, and their arguments are usually so tinged with local sentiments and jealousies that they fail to grasp any problem in a broad way. The Survey is, therefore, a kind of graduate school of instruction for sportsmen who are willing and anxious to learn more about the subject of wild life.

This Federal agency entrusted with the care of our migratory birds is now, and perhaps always will be, in the position of arbiter between groups reflecting very diverse sentiments. On the one hand, there are State conservation officers swayed by popular demands from their discontented sporting elements, and on the other hand, are appeals made from those sportsmen who have invested large sums in the acquisition and

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maintenance of club and private preserves and have conflicting opinions of their own. The owners of public shooting resorts should also be mentioned in this connection. And underneath all this are secret influences at work to hinder in every way the enforcement of Federal laws that conflict with the new business of commercialized game bootlegging. Centralized authority is the only possible tool to cope with such diverse personal and class interests and such varied local conditions.

Before leaving the subject of Federal plans for restoration of water areas, let us touch very briefly on the problems now before the War Department for controlling the Mississippi River floods. In the chapter on drainage (Part II, Chapter I) we have given some idea of the far-reaching effects of drainage in the upper Mississippi Valley. Through the direct agency of man an uncontrollable quantity of water now runs off rapidly and is added to natural floodwaters in all the principal rivers of the system. This accelerated 'run-off' accumulates in the channels of the lower rivers, inflicting untold damage to life and property in neighboring States that were not directly responsible for the present unfortunate condition.

In spite of enormous sums of money spent in devising, constructing, and maintaining levees, revetments, canalization, and spillway projects, the great implacable river continues to wreak vengeance upon man for taking thoughtless liberties with Nature. The lower part of the valley has too much water and the upper part too little and for too short a time. If we are to solve this tremendous problem for all time, we must take a lesson direct from our drainage map and

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immediately plan to restore, through a system of great retention reservoirs, some of the water and marsh areas which once existed. These areas and the power which they can be made to generate will be made useful to man in various ways. We, however, are directly interested in their potential value as reservoirs for 'aquatic farming,' where fish, fur-bearing animals, and wild-fowl can be encouraged. It seems to us probable that the next twenty years may witness the beginning of a gigantic plan of Federal water control in the upper parts of the great tributaries of the Mississippi Valley, for only by some such plan can the great river be brought under complete subjection.

Turning now to the States themselves. It is unfortunate that, since the Migratory Bird Treaty Act went into effect, the States have inclined to lean more heavily upon the Federal Government in the care and protection of their migratory wild-fowl. No doubt the added burden would be gladly assumed by the Department of Agriculture, but no compensating source of revenue to provide additional wardens has become available. Therefore, we are probably a good deal worse off to-day than we were ten or fifteen years ago as regards the public respect and fear so necessary as a background for Federal enforcement. As officially admitted, the business of game bootlegging has increased greatly in recent years and is now so well organized as to necessitate drastic effort if we are to wipe it out.

The various States, therefore, must assume a much greater share of the burden of protecting wild-fowl than was contemplated a few years ago. A Nationwide sentiment against increasing Federal control

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through the agencies of Federal bureaus has gained headway in the past ten years and is now reflected in the general reluctance of Congress to enlarge the scope or increase the powers of any or all bureaus.

This makes it evident that Congress will never authorize sufficient Federal wardens to lift the burden of law enforcement entirely from the States, and the States should now realize that this change in sentiment must inevitably have a direct bearing on the problems surrounding our wild-fowl.

There are many ways in which the States can and should help in a program of restoration of wild-fowl. They can begin to plan for the acquisition of important areas of marsh and water, as recommended by Federal experts in their Nation-wide survey under the Norbeck-Andresen plan. Some of these areas can no doubt be utilized for public shooting grounds under special regulations, and this would receive popular support from among unorganized shooters.

The important wild-fowl States should immediately make a survey of all the club properties and private preserves within their borders, with a view to some system of license which will require a full report of the kill of wild-fowl by species, to be rendered each year at the close of the season. A mass of important information would then be available in estimating the changes in wild-fowl populations. If the States will not do this, then the Federal Government ought to take it up.

Public shooting resorts should also be required to render some reports where they are engaged in exploiting the migratory game resources of the continent for their own personal profit. A great proportion of



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present-day violations are committed in these commercialized resorts, to say nothing of shooting practices which shock the senses of decent sportsmen and all others who know about them. We believe that we have now in the development of these commercialized areas a potential source of danger to wild-fowl far greater than that which threatened them in the old market shooting days.

It is very fortunate for us that Canada has realized the importance of looking after her wild-fowl well in advance of any great press of population. She has set aside with admirable forethought some forty-five Dominion bird sanctuaries, where shooting is for the most part forbidden at all times. Those sanctuaries in Alberta and Saskatchewan are especially valuable as breeding grounds for migratory water-birds.

Besides these sanctuaries there are some fifty-two public shooting grounds, most of which serve as breeding and feeding grounds for at least three months of the year.

Besides all these there are the various Provincial game reserves and sanctuaries, some sixty-five or seventy of them. The larger areas in Saskatchewan and Manitoba include many large lakes attractive to water birds.

We should remember that, as the population of Canada increases, and as roads become more available for motor traffic, our neighbors will greatly increase the toll of ducks taken before the flocks cross our border. This simply means that we must depend less on Canada and more on our own initiative if we are to look ahead far enough into the future. Up to now we have reaped the advantage of sparsely populated

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Canada to relieve us of any special worries in regard to migratory game birds.

Along with all these efforts, individuals who conserve and protect large bodies of ducks on their own initiative should be given reasonable encouragement; at the same time conservation officers should be able to assure the public that there are no abuses taking place on a large scale in these preserves. Where baiting is permitted, and we believe that in some places it may be of real benefit to wild-fowl, it should be carried out through the whole winter season because there is grave danger, especially in the Northern States, that bodies of ducks heavily fed with grain through the autumn will lose the inclination or instinct to seek warmer climates, and therefore suffer from starvation after the waters close up with ice.

There is no doubt that clubs and preserves occupying large areas of ducking waters should be asked to set aside adequate permanent sanctuaries where the birds may be allowed complete rest. Just how this utopian condition can be brought about we do not know, but probably the best way will be through precept and example, not by legislation, which might be interpreted as an attempt to take away from a land owner his natural rights and privileges.

Some sportsmen have suggested that ducks, especially Mallards, might be reared or purchased by clubs on a large scale to balance or offset the drain upon the wild stock. There are many reasons why such a scheme would be difficult to encourage because farm-reared Mallards are too tame to offer satisfactory sport and wild-caught stock soon degenerates in confinement.

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The States, therefore, must, and no doubt most of them will, in time, put into effect programs in step with the Federal plans authorized under the Norbeck-Andresen Act. They must see that all new drainage schemes be subject to careful consideration before legal permission is granted. Due weight must be given to the necessity of the case and the ultimate future benefit to agriculture as against the value of the area in a natural state for healthful recreation, and for the maintenance of the water tables at proper levels. We have already shown that farmers are suffering from a surplus of agricultural land. Old drainage areas which are not showing proper returns, or have become an absolute hardship on the community through the increase in tax rate, should be abandoned outright and purchased by the State, so that water may be restored. Already important developments are taking place in this direction, especially in Indiana, Illinois, and Minnesota.

In conclusion we cannot stress too much the importance of working out and making public an entirely new game policy for the United States dealing with all types of game mammals and birds. As regards the section dealing with migratory birds, absolute frankness is necessary. It is futile to hold out hopes that cannot possibly ever be fulfilled to the rank and file of the sportsmen of slender means. It should be made clear that the available stock of wild-fowl is definitely limited; that there is not nearly enough to go around or satisfy the most modest wants of two million or more duck shooters. And, further, that no matter how desirable, it will be just as impossible to supply equal opportunities to all these sportsmen as it would be to

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divide the resources of the United States Treasury among all the people on some share-alike dream plan.

The sportsman of the future, especially the duck shooters, will have to face a considerable sacrifice in order to engage in his favorite hobby. It is true that along the coast, in spite of almost ruinous competition, he will still have an opportunity to hunt without any great financial outlay, and in some of the State-owned shooting grounds he may still be able to enjoy a limited amount of carefully regulated shooting. These exceptions, however, do not alter the fact that we have available just about so many ducks and that this supply (say from six million to twelve million per year) is very small compared to the demands made upon it.

Conservationists, the optimistic ones, may look forward to the day when we may provide for a greatly increased stock of wild-fowl, but this day is not in sight. The best that we can do, faced as we are with an ever-lessening area of optimum feeding and breeding grounds, is to ensure the maintenance of what stock we have left. Even this would be, in our opinion, a very considerable feat of accomplishment.

We have mentioned the part which the Federal Government, the States, and the individual must assume in ensuring a future supply of migratory game birds. We have not mentioned perhaps the most important groups of all, those that are dependent, first, on the pocket-books of sportsmen, and, second, on the game supply for their very existence.

In our chapter on shooting methods we touch on the business end of wild-fowling (Part IV, Chapter I). We think commonly of only one class of manufacturers



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who are directly interested in the game supply, namely, the gun and ammunition makers. We usually forget the endless production of outdoor clothing, of boats, engines, decoys, and other paraphernalia. We forget, too, that the business of guiding and the care of club properties is a real asset to many impoverished communities.

It is really unfortunate that sportsmen have been taught to regard with distrust, almost with horror, any linkage between the manufacturing interests and the constituted authorities engaged in looking after our game supply. This situation must be absolutely changed if real teamwork is to be developed and brought to bear on problems common to all of us.

The present-day manufacturers are just as vitally interested in a long-term game restoration policy as the sportsmen themselves. They are in a position to look into the future and obtain a much clearer estimate of the trend of the game supply than the average private association composed of sportsmen or naturalists. There has got to be a close working agreement between the commercial interests and the conservation interests. Our altruists and our scientific investigators working on wild-life problems can supply the ideas, but they cannot often communicate them to the rank and file. Here is where the manufacturer can step in and help. He can utilize those ideas that fit into any scheme of permanent practical reform, because his organization can easily be made to reach the farmer and the unorganized shooters in every corner of the country.

And so, too, the influence of the manufacturers, and rightly so, should be dragged out into the light of day

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and made effective before State and Federal law-makers. One trouble is that we have in our midst, as before remarked, a class of propagandists who have always worked to sow distrust of every aim and object of the commercial interests in the minds of both law-makers and sportsmen. The terms 'powder trust' and 'gun trust' have a baneful sound when handed out in judicious whispers to the suspicious lay mind.

We may sum up this situation by saying that a great deal of frank talk must needs be had. The manufacturers, when their projects are for the common good, should not hide their lights under bushels, and the sportsmen should be made to see that unless mutual understanding is complete the anti-sport propagandists will continue to step in and break with some success what should have been a solid front to the four winds.

If we search through literature we are surprised to find that we have always had both here and in England persons of the ultra-sentimental theorist type. They have, of course, a perfect right to their own opinions of the sportsman and all his works. They appear to look forward hopefully to a kind of millennium when the field-glass will supplant the gun and man will dwell in complete harmony with all Nature! But until that blissful age is reached, we must carry on as best we can, realizing that the most important element in securing our future game supply is that great group of enlightened sportsmen whose confidence and co-operation must be retained at all costs.



## CHAPTER II

### WATERFOWL FOOD-PLANTS

IT WOULD be outside the scope of this work to include a detailed discussion of the food habits of our migratory waterfowl, but a brief reference to the important food-plants will be appropriate and of interest to sportsmen and conservationists. Because of the damage directly traceable to drainage, the store of natural foods is sometimes inadequate for the great flocks that invade certain sections of the country, and it therefore becomes the clear duty of every one interested in these birds to protect, and where possible to increase, the supply. There are to-day several reputable dealers who are prepared to supply aquatic plants that are important duck foods, and which are suitable for propagation. It is desirable, however, that the variety of these plants be increased, and also that the planter make selection with a proper knowledge of the conditions most conducive to abundant growth. Failure is frequently traceable to attempts to grow plants that

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are unsuited because of latitudes, bottom conditions, salinity of water, currents, or other factors that should have been understood before the order was placed.

Mr. W. L. McAtee, of the Biological Survey, has made an extensive study of this subject, so we have used freely his reports <sup>1</sup> which have been published as Bulletins of the United States Department of Agriculture. According to his investigations these plants may be classified as follows: 'For salt water, eel-grass; for brackish water, widgeon grass, sago pondweed, and wild celery, all of which also grow in fresh water, the last two abundantly; for fresh water with slight current, wild rice, wild celery, all the pondweeds, and watercress; for fresh water that is quiet except for wind currents, pondweeds, banana water-lily, musk grasses, waterweed, and coontail; for the border line between water and marsh, or for shallow fresh water, delta potato, wapato, wild millet, frogbit, and thalia; for small openings in marshes or other absolutely quiet waters, duckweeds; for the margin of fresh water where there is no marsh, wild millet; for land dry in summer and overflowed in winter, chufa and wild millet; for bodies of fresh water, almost always full but sometimes drying up in summer, in shallow places wapato and delta potato, and in deeper water, the tuberous white water-lily; and for swamps, swamp privet and water elm.'

*Sago pondweed.* — Sago pondweed (*Potamogeton pectinatus*) is probably the best all-around duck food

<sup>1</sup> McAtee, W. L., *Five Important Wild-Duck Foods*. United States Department of Agriculture, Bulletin 58, illustrated, 1914; *Eleven Important Wild-Duck Foods*. Bulletin 205, illustrated, 1915; *Propagation of Wild-Duck Foods*. Bulletin 465, illustrated, 1917.



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in North America. It will withstand moderately alkaline conditions very well, as it occurs naturally in the great Bear River Marshes of Utah, the alkaline sandhill lakes of Nebraska, North Dakota, and other regions. Its importance will be evident when it is known that pondweeds compose a greater percentage of the food of wild ducks than wild rice and wild celery together, two plants that have a notable reputation as duck foods. This is due largely to their wider distribution, as they are found over the entire United States and north into Canada to Hudson Bay and Great Slave Lake. This plant is known also as 'potato moss,' 'duck moss,' and 'foxtail grass,' while in some areas it is confused with eel-grass, although this latter is confined strictly to salt water. Sago pondweed has numerous, long, threadlike leaves which present a loose, broomlike appearance in the water. In autumn small clusters of light brown, nutlike seeds are borne near the surface of the water. In appearance these are somewhat like loose bunches of grapes. The root stocks are tender and bear tubers that are frequently as large as kernels of corn, and these are eaten by several species of ducks. In fact, all parts of the plant are palatable and are eagerly consumed. Sago pondweed is easily planted from the seed, and while the first year's growth may be so delicate as to escape notice, a pond may be filled in the second season, as it grows much more luxuriantly after the root system becomes well established. Planting the tubers will yield quicker results, but these are usually difficult to obtain in quantity. Also the entire plants have been successfully transplanted.

*Wild rice.* — In many of the duck marshes of the

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eastern United States, wild rice (*Zizania aquatica* and *Z. palustris*) is the principal duck food. *Zizania aquatica*, the smaller form, with leaves less than one centimeter wide and usually less than one meter in height, grows principally in the northern part of the northern tier of States and northward. *Zizania palustris*, the larger form, with leaves one and a half centimeters or more wide and two to three meters in height, grows south of the preceding, being especially characteristic of the Atlantic Coast estuaries, the upper Mississippi Valley, etc. Ducks obtain the ripened seeds chiefly from the bottom mud. In early times the grain was annually gathered for food by the Indians, and to-day many people find it a welcome addition to human diet, as it is tasty and nutritious.

The plant is a tall, round, and hollow-stemmed grass with long, flat, pointed leaves. The characteristic flowers usually appear in July, but may be found as late as November. The grains have rounded or pointed ends, are slender, and measure from one half to three fourths of an inch in length. The hull has a long pointed 'beard.'

It occurs naturally from the northern end of Lake Winnipeg and New Brunswick south to eastern Texas and central Florida. It is rather local, but has been successfully transplanted at many points in this great range, particularly in the northern United States from Minnesota and Iowa east to Maine and New Jersey. Investigations of the Bureau of Plant Industry, United States Department of Agriculture, have shown that, with proper treatment of the seed, wild rice may be grown in any favorable waters of the country. Sometimes, however, it refuses to grow in spite of

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every apparent requisite for successful propagation, so experimenters trying to establish this desirable duck food should be prepared for occasional failure.

When handled properly by seed firms, wild rice is kept wet and in cold storage, and is shipped packed in damp moss or fiber. It thrives best on soft fertile bottom. It is not adapted to stagnant water, and is not tolerant of more than a trace of salt, although it frequently grows abundantly on tide flats that are not washed by sea-water. Water in depth of from one to three feet is best, and, since rice is sometimes killed by summer heat when in shallow water, two feet should be the minimum depth for planting in Southern areas. Broadcast sowing answers every purpose and the seeds should be scattered thickly so that the root stocks of the growing plants will support each other. Wild rice may be sown either in spring or fall, but as ice may carry off the seed of a fall sowing, and the ducks and fishes may eat it, spring sowing is probably better, when arrangements can be made to hold the seed until it is needed.

*Wild celery.* — The celery-fed Canvas-back has acquired a celebrated place in the mind of the epicure. Nevertheless, it is by no means proved that the flavor of this duck depends upon a diet of wild celery, for sometimes Canvas-backs are at their best just when grain has figured largely in their menu, or when they have been living on the tubers of sago pondweed.

Wild celery (*Vallisneria spiralis*) is, however, an important duck food, not only for the Canvas-back, but also for the Redhead, and the Scaups, besides many of the shoal-water species, which frequently feed extensively upon the leaves. All parts of the plant are

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eaten, but the tender winter buds and root stocks are relished most. It is a wholly submerged plant with long ribbon-like leaves, from one fourth to three fourths of an inch in width, looking much like common salt-water eel-grass. The long leaves give it the name 'eel-grass' in some localities, although this name is properly applied only to *Zostera marina*, which grows entirely in salt or brackish water, while wild celery is found also in fresh water.

The natural range of wild celery is from central Minnesota, eastern Kansas, and Texas to the Atlantic Seaboard from Nova Scotia south to Florida. It is comparatively easy to transplant, as it may be propagated from the seeds and winter buds, while the plant itself may be taken up and set out at almost any time. The prime requisite is: 'Do not allow the plants, buds, or seeds to dry out or ferment during the time between gathering and planting.' Wild celery grows best in muddy bottoms in three and a half to six and a half feet of fresh water. A slight current is preferable to either stagnant or rapid water. For sowing, the pods (which may be collected by the use of a net or rake in late October and early November) should be broken up (in water) into pieces about half an inch in length. These may be broadcast. It is not desirable to sow too thickly, as the plant spreads rapidly by its root stocks and will soon make a dense growth. If the winter buds or root stocks are planted, they must be weighted. This is readily accomplished by tying several plants loosely together and weighting them with stones by embedding them in balls of clay. The seed pods are best planted in the fall, as soon as possible after gathering, while the winter buds gathered at that time may



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be kept in cold storage and set out, together with young plants collected in the spring, in May or June.

*Delta duck potato and wapato.* — These plants (*Sagittaria platyphylla*, *S. latifolia*, and *S. arifolia*) are close relatives, but the delta duck potato (*S. platyphylla*) is found chiefly in the regions adjacent to the Gulf Coast, while the wapato is found over practically the entire United States and southern Canada. *Sagittarias* are known locally as 'wild potato' or 'wild onion,' and as 'water nut,' 'swamp potato,' 'muskrat potato,' and 'Chinese onion.'

The plant of the delta duck potato will stand about eighteen inches high and has broad elliptical leaves, while the wapato grows sometimes to a height of four feet and has arrow-shaped leaves that vary greatly in length, width, and shape of the point and barbs. The flowers are carried on a spike in whorls of three, each individual flower having three white petals and a yellow center. When the petals fall, the small green balls of immature seeds remain. These enlarge during the summer, and when ripe are brown in color. They crush easily, separating into hundreds of thin triangular seeds.

The tubers or potatoes are produced on the ends of runners, and are largest in the case of the wapato, some being as much as two inches in length by one inch in diameter. Mature tubers of the wapato from the Northwest are more or less flattened and have a shape not unlike that of the body of the common edible crab.

Although essentially fresh-water plants, *Sagittarias* are tolerant of a small amount of salt. They are important food-plants for both shoal-water and diving ducks of several species. Both can be propagated from

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the seeds and tubers, although the latter are the most reliable and will give the quickest results. The tubers are known to retain their vitality when dried, but better success will probably result if the drying is not excessive. They should be shipped soon after gathering, care being taken to see that the packages are well ventilated to prevent heating and fermentation, and should be planted immediately upon arrival. Planting should be done in a mud bottom where the water is not more than a foot in depth. Six inches is preferable.

*Chufa*. — Chufa, or nut-grass (*Cyperus esculentus*), belongs to the group of plants known as sedges. In some localities chufas are known as 'earth almonds' or 'ground nuts.' They are decidedly grasslike and are likely to be so classified by the layman, but their position as a true sedge is revealed by the triangular stalks. The central stalk, which bears the flowers and seeds, may be from one to three feet high, the cluster of grasslike leaves rising from the base. The flower-heads form at the top of the stalk, below which three rather long grasslike leaves project below the fruiting clusters. Chufas are prolific, cultivated plants usually producing one hundred tubers or more. When well developed the tubers of the cultivated variety average about three fourths of an inch in length by three eighths of an inch in diameter, but those from wild varieties are much smaller, frequently being no larger than small beans or peas. They are found from South America north to southern New Brunswick, southern Ontario, northern Nebraska, New Mexico, Arizona, and the Columbia River Valley. They do not appear to thrive in the Great Basin or Rocky Mountain regions.

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Chufas are cheap and can be obtained from most seed houses. They do best when planted in rich but somewhat sandy soil, which if possible should be broken up and freed from weeds. The tubers should be planted thickly in spring just beneath the surface. Obviously they are available as duck food only when the planted area is overflowed in winter.

As a duck food, chufas are known to be important to the Wood Duck, Mallard, Florida Duck, and Canvas-back. Their prevalence in the region of Big Lake, Arkansas, is believed to be one of the reasons why that lake is so attractive to waterfowl, while they are also important food-plants in the overflowed bottom-land marshes of the Illinois River.

*Wild millet.* — Among the duck foods of the United States wild millet (*Echinochloa crus-galli*) or barnyard grass is highly important, being eaten extensively by Mallards, Pintails, Teal, and other shoal-water ducks. Its range extends over the entire country north to southern Canada, chiefly in rich moist soils or swamps. In lower Louisiana it is widely known as 'wild rice,' while other local names are 'goose grass' and 'blue duck food,' the latter name probably resulting from the deep purplish color that is sometimes shown by the fruiting seed-heads. Wild millet is a stiff, coarse, and leafy grass that grows from one to six feet in height. The seeds are borne in dense heads or spikes and are covered with rows of short, outstanding spines, which project well beyond the general outline of the body of the seed. The inner scale terminates in a single spine that may project for two or three inches. This prickly character has caused the plant to be sometimes referred to as 'cockspur grass.'

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Wild millet requires a moist and preferably rich soil and it will grow in water at least a foot in depth. It cultivates easily and reseeds itself. The seeds should be sown in spring and it is advisable to discourage other plant growth in the area selected for its cultivation. When once established, it will take care of itself. Like chufa, it is a splendid plant for use in low lands that are or can be flooded during the season of duck abundance. The seeds are sold under the name 'barnyard grass,' one variety having been advertised as 'Japanese barnyard millet' or 'billion dollar grass.'

*Banana water-lily.* — The banana water-lily (*Nymphaea mexicana*) is a native of Florida and other regions on the Gulf of Mexico. It is one of the ornamental varieties of water-lilies, and we are informed that it is hardy, and when covered with adequate water (one to five feet) it will thrive as far north as New York City. It is abundant locally in Louisiana and Texas. At Belle Isle Lake, on the Paul J. Rainey Wild Life Sanctuary, Louisiana, a patch of these lilies is such a potent attraction for Canvas-backs upon their arrival from the North that they entirely ignore the grain supplied by the Superintendent, until this natural resource has been exhausted. At Lake Surprise, Texas, it has been found to constitute nearly half of the entire food of the ten species of vegetarian ducks that there occur. This is particularly remarkable, since sago pondweed, a notoriously favorite food, also is found in this lake. The leaves of this lily, like those of the common spatterdock, are more or less circular or heart-shaped, with the stem attached at the base of the cleft. The flowers are yellow, but may be distinguished from those of the spatterdock by the fact that the ovary is



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practically hidden by the abundant stamens, while in the opened flower of the spatterdock, this part is plainly visible. The root stocks bear some resemblance to an unopened pine cone and vary in diameter up to two inches and in length up to twelve inches. Ducks will swallow those up to three-quarters of an inch in thickness. Tender white runners extend out from the root stocks, and while in summer these give rise to new plants, in winter they form peculiar, yellow, hibernating bodies, the appearance of which strongly suggests a miniature 'hand of bananas,' hence the proposed vernacular name which is being rapidly accepted.

The banana water-lily requires abundant sunlight, water from one to three feet deep, and a mud bottom. It is not injured by slightly saline waters, as is shown by its presence in lakes close to the coast where a certain amount of salt water is brought in by the tides. The root stocks may be planted merely by weighting them with stones and dropping them where desired. They have great vitality and may be readily shipped if ordinary precautions are taken to prevent excessive drying. Transplanting may be done at almost any time of the year.

*Widgeon-grass*. — Although widgeon-grass (*Ruppia maritima*) will grow in saline water, it probably never thrives in full-strength ocean water. It does best in brackish waters such as are found at the heads of bays and inlets where there is a plentiful admixture of fresh water from rivers. It is found from the Gulf of St. Lawrence and the base of the Alaska Peninsula, south to Central America, a number of different forms being included in this general range. It occurs at scattered points in the interior where there is the proper amount

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of salt to produce conditions suitable for its existence. In spite of a somewhat restricted range, widgeon-grass is of much importance as a duck food and is eaten both by shoal-water and by diving species.

In many ways widgeon-grass is similar to sago pondweed or foxtail, but can be readily distinguished upon close examination. It has the long, slender leaves rising from widely spreading, much-branched stems, but the seeds are borne singly in rather long stalks which radiate from the top of the fruiting peduncle, in contrast to the compactly grouped seeds of sago pondweed. The root stock is tougher, more frequently jointed, and is often angled at the joints. There are no tubers. The seeds are black, rounded triangular in outline, with a small pit on each side near the apex, while on one edge there is an oblong lid which is forced out during germination. The pondweed seeds have similar lids, but are usually larger, are never black, and lack the apical pits.

Widgeon-grass ripens in late summer and early autumn. In collecting the seeds about six inches of the plant should be left attached, which tends to keep them from drying. Free circulation of air is essential to prevent fermentation, so the seeds with sections of plant attached should not be tightly packed. If it is necessary to store them, they may be placed in wet cold storage, but it is advisable to plant as soon as possible after gathering. After soaking the seeds until they will sink, they should be broadcast in quiet water over a mud bottom. They will grow in water from a few inches to ten feet in depth, but do best when planted in water that is permanently from one to two feet deep

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*Eel-grass.* — Eel-grass (*Zostera marina*) is strictly a maritime plant and is one of the favorite foods of the Brant. In fact, the relationship between the Brant and eel-grass is far closer than that existing between the Canvas-back and wild celery. It also is eaten more or less extensively by ducks of several species, especially in the attenuated form that it assumes in partly brackish water. It occurs naturally on both coasts from Alaska to California, and from Greenland to the Gulf of Mexico.

The plant consists of bunches of long, tapelike leaves which rise from a jointed, fibrous-rooted, creeping stem. The leaves bear a strong resemblance to those of wild celery, but they are rarely more than a fourth of an inch in width, while the leaves of wild celery are seldom so narrow. If a mature leaf is torn across, the broken ends will show many white fibers, which are lacking in the leaves of wild celery. The root stocks are usually of a reddish color, and have joints about every half-inch, at which they are easily broken. The seeds are found in sheaths alongside the leaves. They are barrel-shaped, measure about one eighth of an inch in length, and are placed end to end. The surface is conspicuously ribbed longitudinally.

As we have said, eel-grass grows only in salt or nearly salt water, and as the seeds are not well protected against drying, they are not satisfactory for artificial propagation. It is best to use the root stocks, which should be buried or fastened to the bottom in a few feet of water where there is little surf. The roots are rather tough and resistant, but must be kept wet, and handled as rapidly as possible. When once established, eel-grass will spread over considerable areas.

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*Musk-grasses.* — The musk-grasses (Family *Characeæ*) belong to that great group that are known as algæ. Most of the different species live in fresh water and are known by such local names as 'frog spit,' 'sea-weed,' 'stonewort,' 'oyster grass,' 'skunk grass,' 'fine moss,' 'green slime,' and 'nigger wool.' The name 'musk-grass' refers to the strong odor given off when freshly taken from the water. All parts of the plants are eaten by ducks. Musk-grasses are found over the entire United States, but most species require an abundant supply of lime, a fact which should be considered when their propagation is contemplated.

The plants have slender jointed stems, whorls of fine tubular leaves being borne at the joints. The reproductive organs are carried on the leaves, which gives them a beaded appearance. Musk-grasses are fragile, translucent, and dull green in color. They are attached to the bottom over which they may form a fluffy blanket a foot or more in thickness. The tubers of some species are found in numbers on the rootlike organs or rhizoids.

When transplanting musk-grasses, they should be gathered in quantities in late summer or autumn and packed for shipment in small units (such as berry crates) that are open on all sides to the air. A little drying will not injure them, but if the shipment is to go a long distance, the package should be iced. To plant, it is necessary only to tie bunches of the plant together, weight with a stone, and drop to the bottom. They will grow on almost any kind of bottom, providing, of course, that the necessary lime is available.

*Duckweeds.* — There are many species of duckweeds, some of which occur throughout the United States,



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while others are confined chiefly to the eastern or southern part of the country. They are abundant only under special conditions, but as these conditions exist in some of the principal habitats of wild ducks, duckweeds contribute largely to their support.

Generally they are of small size, individual plants varying from one twelfth to three fourths of an inch in diameter, while two genera lack roots, feeling and appearing like coarse green meal. In fact Mr. McAtee suggests that a good name for these would be 'water meal.' Duckweeds are frequently abundant about the margins of lakes and ponds, sometimes literally covering the water.

As the seeds are minute and seldom mature, the entire plant must be transplanted. This is, however, easily done, providing the plants are not crushed or allowed to ferment while in transit. If the shipment is to be transported a long distance, it should be iced. Duckweeds are perfectly at home from the moment that they are placed in a new body of water. It is useless to attempt to start them in large areas, and they thrive best in small ponds or ditches where the water surface is rarely disturbed. In the North they will sink on the approach of cold weather, but in the South they remain at the surface practically throughout the year. They are strictly fresh-water plants.

There are several other important waterfowl food-plants that with proper care can be successfully transplanted from one place to another. Among these are Frogbit (*Limnobium spongia*), Thalia, Water Elm (*Planera aquatica*), Swamp Privet (*Forestiera acuminata*), Watercress (*Sisymbrium nasturtium-aquaticum*), Waterweed (appearing in trade catalogues under various

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scientific names, as *Philotria*, *Elodea*, and *Anacharis*), and Coontail (*Ceratophyllum demersum*). Mr. McAtee does not recommend the last three for planting in waters where other plants may be also desired, as they produce such rank growths that they are likely to take complete possession. They are, however, well adapted for use on duck farms.

We have endeavored in this chapter to show how sportsmen and conservationists can serve the best interests of the wild-fowl and thereby their own interests by taking active steps to increase the supply of natural food. Before concluding, however, it is appropriate to refer briefly to some of the enemies of waterfowl food-plants. They are fed upon by domestic horses and cattle and also by moose, deer, and muskrats. It is not believed that any of these animals do lasting harm to a thriving bed of aquatic plants, but the introduced carp is, in many regions, a serious factor in the maintenance of a supply of food-plants. Already in some areas it has been responsible for the complete extermination of such important plants as wild celery, wild rice, and pondweed. Although a rough fish of a most inferior grade, it unfortunately has an active market, particularly among the Jewish populations of the larger cities, so its extermination (if such were possible) would certainly be opposed by some commercial fishermen who largely depend upon it for their livelihood. By drainage and netting it can, however, be completely eliminated from the small lakes and ponds selected for waterfowl feeding grounds and where intensive propagation of aquatic plants is intended. The inlet must, of course, be carefully screened to prevent further infestation, but considering the de-

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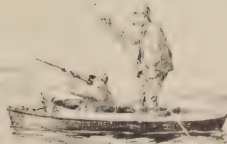
struction caused by these alien fish to our valuable waterfowl food-plants, almost any resort to exclude them is well worth while.

In conclusion we call the attention of our readers to the expert advice available for the asking from the United States Biological Survey. Mr. McAtee and his associates have personally examined the principal waterfowl areas in the country and so are able to give authoritative information concerning the plants best adapted to the local conditions. In purchasing seeds, tubers, or root stocks, it is good practice to consider the geographic location of the dealers and order from those which will assure the shortest possible time in transportation. The Biological Survey maintains a list of dealers in waterfowl food-plants, which is sent free upon request.

PART IV  
SPORT AND SPORTSMEN







## CHAPTER I

### METHODS OF TAKING DUCKS, WITH SOME REMARKS ON THE ETHICS OF THE VARIOUS PRACTICES

NEARLY every part of the country can boast of some special method of shooting wild-fowl. There are different kinds of boats without limit, many varieties of floating and stationary blinds; all sorts of decoys — live ones, wooden ones, cork ones, canvas-covered decoys, and tin or wooden profiles. There are duck calls, too, made of almost every sort of material, size, tone, and effectiveness; but mostly useless unless in the hands of an expert. Guns are not within the province of this chapter excepting in so far as we must mention again repeating and automatic weapons and their effect on game in general.

Last, but in recent years extremely important, is the use of bait in holding ducks. This must be taken into consideration in any account of shooting methods in use to-day.

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Generally speaking, the greater refinements of impedimenta and technique are to be found where fowl are either scarce or thoroughly educated to nocturnal habits through intensive hunting. The Indian hunter in the James Bay regions can get ducks up to his gun by placing himself in the track of ducks, squatting down in the grass, with his unaided voice as a duck lure, and his hat waved occasionally above the grass-tops to attract the attention of passing fowl. He has the advantage of being able to hunt young unsuspecting birds early in the season in a region that is not overshot, and he does not have to worry about the shooting qualities of his gun or the strength of his powder. Any sort of a tube that will hold shot is good enough for him.

Contrast such simple methods with the elaborate goose camps of eastern Massachusetts, where a team of two hundred or three hundred live decoy geese are kept on the beach throughout the whole flight season, besides a gunner to look after the rig as well as a cook to keep the camp in order. The Indian with his musket and his black felt hat would soon starve in Massachusetts.

This subject of hunting methods is far too big a one to crowd into a chapter, nor is there any need to go into details, because the older books, especially George Bird Grinnell's 'American Duck Shooting,' have covered the ground thoroughly. An entire volume might be devoted to the different types of boats or rather floating devices used. Sculling floats in great variety adapted to all sorts of conditions: tidal marshes, open rivers, shore marshes, and new or old ice. And boats that can sail on ice or water like the

*White-winged Scoter*

*Black Scoter*

*Surf Scoter*

*American Eider*









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Long Island 'scooters.' Boats for carrying large rigs of 'stool' ducks towed behind a power boat or sailboat with perhaps a sink-box lashed across the gunwales; houseboats built especially for a large party on wild-fowling expeditions; sink-boxes of the simple types used in New Brunswick and the latest double 'sit-up' patterns for the Middle Atlantic Coast.

There are the gray New England 'cooting' dories built to ride the heaviest offshore swell, and shallow coffin-boxes that can be dug into a sandbar and hidden like a floating battery. We have shallow-draft boats built to be propelled by a pole, or sailed when the wind serves, large enough for a couple of men, a dog, and fifty or one hundred stool ducks with other shooting paraphernalia. And we should not forget the retriever dogs, Chesapeake, Labradors, Irish water spaniels, and a wide variety of mongrel water dogs containing Newfoundland, Spaniel, Setter, and other strains.

It would be extremely interesting and instructive if we could get some idea of the total amount of investment in wild-fowling equipment the whole country over. Take, for example, the two thousand-odd duck clubs in the United States. Many of these own a couple of gasoline boats, ten or fifteen duck boats for use in going to the blinds, sails for the same, and perhaps a few retriever dogs.

All clubs certainly have several sets of wooden decoy rigs and a number of boxes, either of wood or cement, which have to be kept in repair, moved from time to time, or reset. There may be a horse or two used to keep the ponds baited and to transport a big rig of live decoys, and probably nowadays a motor truck. Some clubs keep large teams of live goose decoys, which must



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be fed every day of the year and if possible increased by breeding, while most of them have a flock of live ducks. We have not mentioned the investment in land nor in living quarters, which last may consist of a small hut or a commodious dwelling with all modern conveniences.

Those clubs which depend on water transport often own an elaborate cruiser boat where the members can eat and sleep. The investment in equipment of clubs must run from two to three hundred dollars at the lowest to twenty-five or fifty thousand at the other end of the scale. If we take three thousand dollars as a low average, we arrive at a rough figure of six million dollars for the sporting equipment of our clubs alone, exclusive of all the real estate.

But do not forget the individual duck shooter who has a very considerable investment himself. He owns a set of warm clothing at the least, plus waterproof outer garments, one or more pairs of rubber boots, a few live and wooden decoys, and a canoe or skiff, besides his guns and his shells. Put him down at one hundred dollars per man and we get an investment of \$100,000,000 to \$200,000,000 in sporting equipment according to the number of duck shooters which we may estimate in all these United States.

By way of explanation we should notice here that the 1927-28 figures for sporting licenses in the United States total nearly 6,500,000, and we estimate around 500,000 more of shooters who for one reason or another, legal or illegal, do not take out licenses. This means that we have nearly 7,000,000 shooters, of whom from 1,000,000 to 2,000,000 certainly shoot ducks.

Of this number there are probably at least 30,000 or 40,000 club members in the two-thousand-odd clubs.

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State records disclose less than 50,000 non-resident licenses sold in all the United States, which would seem to indicate that a great many visiting sportsmen do not take out any special license. Some of the States are certainly losing a great deal of revenue from this 'leak,' and should attempt to collect from the non-resident who shoots with a local license.

And now we will consider for a moment the methods of duck shooting in relation to the ethics involved. But it certainly would be absurd to attempt any hard-and-fast ruling as to what is sportsmanlike and what is not, for practices which are frowned upon in one region are almost necessary to secure any game in another region where fowl are scarce or harder to come by. A man might 'gun' for several weeks in our Northeastern States without getting a decent shot at Black Ducks, so that we may perhaps excuse him when, after many hours of patient watching, he gets a chance to shoot five or six ducks on the water. His case may be likened to that of a big-game hunter, who has crept over the mountains for many a weary week trailing a big ram and when at last his well-earned chance comes, it is not likely he will care to risk a running shot.

There is no doubt that the most difficult and so the most sportsmanlike method of hunting wild-fowl is by still hunting from a scull float. This requires almost a lifetime of experience, especially on salt water, where an intimate knowledge of the ice conditions, shoals, and currents is necessary. Sculling means hard work, for the game is approached on even terms and has every opportunity to size up the enemy. But sculling can be practiced successfully only in little-disturbed waters, and such are not easily found nowadays. Since night

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shooting has been made illegal, the best chances for the 'float' shooter are gone. It is not surprising, therefore, to find this method dying out, both in the East and in the Mississippi Valley. In some cases the very type of boat used twenty-five years ago is all but forgotten and its local manufacture becoming a lost art. Sculling now is chiefly practiced by those rascals who defy the law and creep about at night with a huge punt gun. A few of these renegades still manage a precarious existence in the waters of Chesapeake Bay and along the coast of North Carolina.

The next most sportsmanlike method of hunting ducks is by crawling up to them in pond holes and taking them on the rise. Walking up ducks in a marsh is arduous and difficult and not to be recommended unless a good dog is kept at heel to bring in the game, which otherwise as likely as not will be lost in thick cover. But it is certainly sportsmanlike. The point we wish to bring out is that a duck killed by still hunting is a duck usually well earned, and large bags can rarely be made in this fashion. The bushwhacker and the beach-prowler are not popular figures; nevertheless, they have chosen just as sporting a method as that entailed by watchful waiting behind a large flock of decoys.

Overhead ducks on a flyway or duck pass certainly provide the most difficult and fascinating sort of shooting to be had anywhere, and lucky is the hunter who can happen upon a place where he can engage in this trial of skill. Few, indeed, have ever seen a duck pass in all its glory. An intimation of such shooting can be had in our Western sloughs, where guns can be stationed and ducks driven over them by one or two men on horseback riding to the opposite end of a pond. This

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was a very pleasant method of shooting in Montana along the foothills of the Rockies when we were younger and we have put in many pleasant days and made moderate-sized bags without decoys, blinds, or bother of any sort; just a good horse and a coat full of shells.

Shooting over stool decoys is perhaps the commonest, most agreeable, and in most cases the easiest way to get ducks; that is if everything works out as it ought to. But the exception in duck shooting can be usually taken as the rule, and in any overshot ground the good days are the boisterous days. The gunner must be ready to stand every test of weather and every shift of the wind. So what looks easy in a picture book may not be so in practice.

There are two rather sharply divided kinds of shooting with stool ducks, the point shooting and the pond-hole or marsh shooting. The out-point facing a large body of water provides a more difficult brand of sport, more variety of game, more diving ducks, and perhaps more geese. The birds do not come so close and as a rule fly faster and decoy less readily. Retrieving the dead and winged birds is often difficult, sometimes dangerous, and always arduous in a gale of wind. In the simplest form of point shooting, the gunner can dig himself a hole at the end of a sand-spit, and if the wind is strong enough to push crossing birds over the land, he can drop his game on the open ground where there is no trouble from cripples. But he must resist shooting at all birds that will drop in the water where it is too rough to launch a boat and too deep to wade. This kind of flight shooting is rare, indeed, on the Atlantic Coast and usually to be had at inferior kinds of sea-ducks.



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Far easier for the beginner is a well-built blind, or, better still, an ample box sunk on the border of a marsh-pond where the fowl have not been disturbed. Usually the out-point cannot be successfully baited, but the quiet pond can be so carefully prepared on a preserved marsh that on a good windy day the lucky gunner is almost certain to have many shots. His shooting, too, is often at hovering Mallards and Pintail, and he is, indeed, a slow hand who cannot drop such birds with fair frequency. Such fortunate gunners are apt to regard with some scorn their less well-situated brethren who cannot easily find a place where wing shooting can be had, and are reduced to the more lowly practice of hut shooting over live decoys, to beach-prowling, or other humble practices.

A third category of shooting over stool birds is that done from floating devices like the sink-box (battery) or floating bush blind as well as the stationary bush or so-called 'mat blind.' These rather deadly devices are used mostly for taking diving ducks in broad waters where ducks cannot be got at from the shore. Devices of this sort are regulated in various ways by State, County, and Federal law, to the end that they may not be too numerous on small bodies of water. But regulations are not too successful in keeping the peace, because the 'stake' blinds and batteries are used by native shooters in competition with non-resident owners of marshes and islands. The battery or the 'staked' bush blind placed too close to a shooting point may easily ruin that point, and much local ill-feeling is the unfortunate result.

It is very evident that too many batteries or other devices placed on feeding grounds defeat their own

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purpose and eventually ruin the shooting, but it is difficult to devise any fair way to keep their numbers within reasonable limits. The present Federal ruling, already once modified, is a well-meant attempt to control the number of batteries, but the problem is yet a long way from being solved.

Originally the battery was looked upon as largely a commercial killing device and for this reason it was frowned upon by amateurs as unsportsmanlike. But in our own opinion, shooting from a battery is usually far more sportsmanlike than 'tying out' at a baited pond-hole and is certainly more difficult. In setting the battery, one gambles on his knowledge or 'hunch' concerning the habits of the fowl, and very often loses out completely. As a rule the battery shooter must be more active with his gun and better able to stand cold and a cramped position than the shooter in a marsh blind. His rig is larger and has to be kept in constant repair. At least two hundred to three hundred stool ducks are necessary as against twenty-five to fifty for the ordinary marsh rig.

Stool ducks were used here long before the white man arrived. In Indian mounds very creditable decoys of straw have been discovered. Northern people have probably always used the skins of Eider and other sea-fowl drawn over a bit of wood in place of a painted imitation. The white man cannot flatter himself that he has invented anything very novel in this respect.

Most of the ancient practices of killing wild-fowl by means of snares, nets, and combinations of sling-stones and entangling lines are rapidly dying out since the more convenient, as well as more deadly, shotgun has

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found its way into every farthest corner of the Arctic.

More primitive even than the stool ducks of Indians and Eskimos are the mud decoys turned up with a spade and used so successfully on the great flats at the mouth of the Bear River in Utah. Many a duck, and goose too, have we ourselves lured up to bunches of wet eel-grass pushed up in the form of a small haycock on the tidal flat or hung over a couple of sticks driven into shallow water for support. These mud and weed lumps have the great advantage of not glittering or bobbing about, and in the days of night shooting could be built as large as one wished for shooting in the uncertain twilight.

The daily news-sheet has often served a novel purpose for decoying Snow Geese on the beaches of Currituck, and for aught we know on the prairies of the Northwest. Pigs' bladders were formerly the favorite 'coot' decoys on the Northeastern coast, and being light they were also carried in strings by the night shooters in their forays after Black Ducks.

But most stool ducks are made of white cedar or of white pine, while some of the very best are fashioned of cork, roughly burned to a dark brown color on the surface so as to get rid of sun glitter. The usual wooden commercial articles are very badly turned out and hopelessly crude in appearance, worse it seems to us than they used to be. The sportsman who derives any satisfaction in tying out a fleet of workmanlike or artistic products must either make them himself or have them cut out and painted to his order by a person who takes real pride in his work, and has plenty of spare time beyond the eight-hour day.

Some of the best goose decoys are put together on

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the principle of a canvas-covered canoe, water-tight and very light. In Massachusetts, these canvas goose decoys have been made three or four feet long to be anchored out on wooden triangles in the middle of a large pond or bay. Here they float the whole season through and attract geese at a great distance.

When stool ducks can be rigged on frames, they will do far more effective work because in a sea-way they do not bob and rock with the unnatural motion of a single anchored decoy duck.

A fleet of stool ducks can also be rigged on an endless line and hauled off several hundred yards into a pond by means of a sunken buoy. Redheads and other diving ducks will sometimes follow a moving flock of such decoys until they are close to the concealed shore gunner. But such methods require quiet waters and plenty of time between shots.

It might be well to mention here other types of stool ducks which at one time or another have had a certain vogue, or at least have provided a successful lure to entice the ever-credulous gunner up to the counters of a gun store. Such things are the various 'blow-up' canvas contrivances that smell like a sailor's oil jacket and turn over on their sides at the smallest puff of wind. Others, more effective, are made of canvas and wire, folding down upon a light wooden board, easily transported, but not very lovely to look upon.

Wooden and tin 'shadow' decoys are used mostly for Western goose shooting either on river sandbars or in grain-fields. Shadow Brant decoys are also in use for marine Brant shooting on sand-spits and bars along the Massachusetts coast and in other places.

There is a very clever invention of the Coot (Scoter)



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shooters in New England and New York, where double shadow decoys are set up, one at each end of a floating board. Such boards are attached by ropes, one behind the other, and so made that a dozen pair mesh inside each other, taking up little space in the boat, but making a grand show in the water when they trail out in a long line.

In many of the older works on shooting, much space was devoted to the art of taking ducks by using a red flag or handkerchief to 'toll' Redheads and Scaups toward shore. The tolling dog, trained to gambol about on the beach or chase chips of wood, is an ancient method which also takes advantage of the curiosity of undisturbed fowl. The dog has been used to attract ducks in connection with the working of Dutch and English decoy ponds for hundreds of years, so that this method is certainly not an American discovery.

This art of 'tolling' ducks, once common on Martha's Vineyard Island in Massachusetts, and in many of the Redhead and Canvas-back waters of the Chesapeake, has now, we believe, completely disappeared. Although it was not perhaps a 'sporting' method of taking ducks, it provided the sort of conditions where patience and judgment were the chief requisites. It must have had much of the fascination that we experience to-day in watching a flock of very shy fowl gradually drifting in toward the hidden shooter, lured by a beach team of live decoys. In other words, the old time 'toller' had the sensations of a big-game hunter who lies for hours watching his quarry gradually feeding in his direction.

Live decoy ducks came first into use in New England and perhaps in other waters near New York at least one hundred to one hundred and fifty years ago.

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Audubon mentions the fact that gunners near Boston were keeping live ducks about the year 1830. Decoy Canada Geese were not used until a later date, and were certainly the exception in New England until about 1850. Sir Charles Lyell, the English geologist, mentions seeing a tethered goose in a pond in Weymouth, Massachusetts, in the autumn of 1845.

The earliest teams of live goose decoys were developed by cobblers in Massachusetts who 'gunned' migrating geese from small concealed camps built on the shores of many of the large ponds southeast of Boston before the Civil War. Later on, in the sixties and seventies, the beach teams of live geese were supplemented by trained litters of young geese flown from pens built on rising ground back of the camp or stand, as one of us has described in 'Shooting Stands of Eastern Massachusetts' (1929).

To-day there are some five thousand decoy geese in eastern Massachusetts alone, and their use has spread all the way down the Atlantic seaboard as far as Canada Geese migrate in winter. In certain beach towns on the coast of Virginia and North Carolina, their breeding has become almost a business. It is safe to say that there are fifteen to twenty thousand live goose decoys on the Atlantic Coast alone. Many also are used for sandbar shooting along the Mississippi River, the Platte, and other wide, sandy goose rivers of the West, but in places where geese frequent wheat and corn fields, the silhouette decoy is much the handiest.

There is perhaps an excuse for using live geese, when, as in Massachusetts, few geese can be taken in any other way, but it seems unnecessary to employ large teams where geese winter in thousands and where they

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can be shot by simpler methods. The trouble with using live geese is that it leads inevitably to the 'swimming' shot.

Live swans have been used for swan shooting in Currituck, North Carolina, these being simply winged birds captured by gunners, but since it was declared illegal to shoot swans, these most ornamental of all decoys have vanished.

In only one place, so far as we know, were live Brant (*Branta bernicla*) used as decoys, and that was at Chatham, Massachusetts, in the old days of spring shooting. The birds so used were cripples carefully saved from year to year until the Brant clubs of Monomoy had good stands which they used on the sandbars together with wooden decoys. Flocks of wild Brant were 'swum' up to the boxes and shot mostly on the water, a method which sounds, and perhaps was, murderous, though large bags were the exception in spite of the elaborate rigs in use.

Live decoy ducks are now so generally used that they have almost come to have first place in the wild-fowler's equipment. Attempts have been made locally to discourage their use by law, but it is doubtful whether sportsmen would consent nowadays to abandon them except where wild-fowl are so abundant or so unsophisticated as to render them unnecessary.

Live decoys in themselves are perhaps a harmless refinement to the fowler's rig, and certainly their playful actions and constant movement help to amuse the sportsman on many a dull day. But when we bring into play live decoys, repeating guns, and unlimited intensive baiting, we have a combination capable of tremendous abuse. For instance, in some places, such



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as the Illinois River bottoms, great wire pens holding fifty or sixty live decoys surround the baited blind and with repeating guns used 'on the count,' a great many 'limits' may be shot out of one blind in one shooting day. It is true that too intensive shooting always tends to defeat its purpose, and in consequence relieve the strain on the duck population, but the baiting idea can be overdone, at least from the standpoint of sporting ethics.

Live decoy ducks are simply Mallards of various strains, often with a dash of domestic, Black-East-India blood. They are bred very small like the English toy Mallards or 'call' ducks and in every intermediate size to the large dark birds which show well at a distance. As a general rule, the smaller, rounder-headed, shorter-billed call ducks have the highest-pitched voices and are more loquacious by nature. The larger birds are deeper-voiced and more sedate. The large dark-colored birds work better in salt marshes where decoys should not be too noisy, especially late in the season when the game is wary. When decoys are used on the wing to fly about and attract migrating ducks, as they are in Massachusetts, they should be bred rather small, but not too wild to prevent easy handling. Pure wild Mallards usually are useless as decoys and wild Black Ducks are even worse, since they are shyer than their cousins the Mallards.

We have always wanted to see a large team of live Pintail decoys and we think these could be produced by crossing with Mallards and then crossing back to male Pintails so as to produce a three fourths Pintail that is reasonably tame. We have reared many of such birds ourselves for other purposes, but have never used



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them as decoys. If Baldpates could be bred tame enough to call at a stand, which we very much doubt, a new string could be added to the fowler's bow. We make this suggestion with some hesitation, but in the belief that of all game ducks, Pintails and Baldpates are the best able to take care of themselves under modern conditions.

With many species of ducks, it might be easy to tame a few individuals for decoys, provided that little or no shooting was done over them, but we have seen fine teams of Mallards that were bred a little too wild become almost useless through fright from gunfire. The problem would be to produce a strain of Pintails so tame that they would continue to call after volleys were shot over them.

Live decoy ducks are used in various ways. The simplest method is to carry a few in a sack over the shoulder and stake them out among a flock of wooden decoys. There are various forms of soft leather 'strads' so cut as to make a safe noose about the leg that will not chafe and will not pull so tight as to cut off the circulation of the duck's leg. Swivels and snaps are almost necessary to prevent kinking of the anchor line and besides that they save time in setting out the ducks. Some gunners hitch ducks by both legs, as geese are usually hitched, since they are supposed to sit more contentedly if the anchor line pulls on both legs instead of one.

Another scheme is to anchor ducks by a ring around the neck, which is said to be a very satisfactory way of anchoring ducks.

Nowadays, a favorite method of using ducks is to pinion them and let them swim naturally in a large

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wire pen close to the blind or box. At other times, large pens of ducks have been used in the middle of a pond to attract wild ones into the pond and get them to using the bait provided. Goose decoys are also very frequently displayed in a wire pen which saves the trouble of hitching them.

When ducks are shy and scarce, as in eastern Massachusetts, we find the most elaborate systems for working live decoys. A string of five or six well-seasoned birds is hauled far out into the pond on an endless underwater line, or there may be two of such 'runners.' A certain number of ducks are anchored near the shore and a large number of full-winged birds kept in handy, easily opened coops. These free winged birds are called 'flyers' and can be tossed out over the stand fence at a moment's notice to attract passing birds and also to set up a racket among the 'beach' and 'runner' teams. These 'flyers' must be constantly handled and carefully fed, not overfed, so that they will respond to the trainer's call and come back into the stand as soon as they are called.

It is almost an art in itself to train full-winged Canada Geese so that they can be handled from a fly pen; to have them so tamed that they will instantly jump from their pen platforms the moment the sliding door is raised, and, after circling around the pond for a few minutes, sail in and alight on the beach in front of the stand. They must be tame, yet not too tame, for overfed birds make too short a flight.

Artificial duck calls are contrived, as a general rule, more with a view of decoying the unwary buyer than to lead the ducks to destruction. We in the East have heard more good goose callers than duck callers and our

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Eastern gunners mostly use their own throats. Duck calls have their greatest usefulness when shooting in flooded timber locations where the stool ducks either are not used at all, or, if used, are invisible to high flying ducks a short distance away. In the Mississippi Valley, more attention has been paid to the fine points of calling, and some individuals, building their own calls, have developed an art little short of the technique of a high-class musician.

Calling ducks without the use of stool decoys is one of the most satisfactory and sportsmanlike methods of bringing ducks to the gun. We remember with a real thrill the few occasions when lying concealed beside some woodland pond we have coaxed a single old drake to swim across into gun range by imitating to the best of our ability the subdued conversation of a lady duck. But the wheeze of a drake is quite beyond the powers of the human talk machine.

We have touched on the subject of bait several times in this chapter. Many kinds of grain are used to feed ducks — maize, wheat, barley, whole rice, broken rice, rice 'millings,' and 'red' rice. So far as we are aware, rye and oats have not proved very useful. When large amounts of grain are purchased, second grades or damaged grain can usually be obtained at a very low figure, the principal cost being that of transportation and bagging.

The possibilities lying behind the use of bait were not realized until twenty or thirty years ago. Naturally the custom of baiting developed hand in hand with the increase in private preserves and clubs. It was useless on most public areas and of course it always will be. When one club began to use bait, a

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neighboring club soon found it necessary, for the birds followed the corn, and so the system of baiting became firmly established in a very few years.

Although there was some jealousy among clubs, particularly when a club that could ill-afford the additional assessment was forced to bait in competition with a larger and richer club, the ill-feeling in general was small in comparison with the dissatisfaction of the unorganized shooter. That individual began to look about him, and saw that ducks were getting more concentrated on certain well-fed waters and scarcer outside of them. Also, he perceived that new flight lines were established in response to a full dinner pail. Some bodies of fowl came so easily by their food that they did not require to move about, at least during daylight hours; hence they were almost impossible to get at except on the preserved ground.

The net result of it all is something like this: those who bait extensively have taken upon themselves a considerable responsibility. It is possible in a quiet spot to lure a body of birds entirely away from their usual haunts and bring them to a spot where they may be dealt with as the owner of the property pleases. They are entirely at his mercy. Bait has greatly increased the effectiveness of preserved waters, and, conversely, has reduced the shooting on overshot and underfed waters. This has widened the gap between the land owner or lessee of ducking property and the unorganized shooter who depends on his wits and energy rather than on his purse. All this applies, of course, more to the surface-feeding or marsh ducks than it does to the diving ducks.

We believe that baiting can be overdone, and yet it



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is a very debatable point as to whether it could or should be made the subject of special legislation. Conditions vary so much from coast to coast that any Federal ruling, even if it could be enforced, which obviously it cannot be at the moment, would be poorly received in some quarters. It would be a start in the right direction if the clubs of the various ducking regions would get together and adjust their own problems before they are forced to submit to State or County regulations.

Heavy baiting close to a shooting stand cannot be classed as a particularly sportsmanlike practice. Baiting at a certain distance from a stand is, we think, less objectionable, and we should like to see this practice taken up everywhere by common consent.

When a club baits heavily from September to the last of January, it would seem to us that it has assumed a certain obligation, when ducks are still resident at the end of the season, to continue the practice until early spring. It is more than probable that a body of heavily baited ducks tends to stay in the neighborhood of bait far longer than they otherwise would, and by so doing they may lose the migratory impulse which would have taken them to more favorable wintering grounds. We know, for example, that the migratory impulse in certain perching birds can be broken by forcible confinement for a short period in early winter so as to make it impossible for those particular individuals to continue their journey southward.

We believe that every club or preserve should set aside a sanctuary the size of which should be in proportion to the total holdings, and such a sanctuary area should be maintained year after year until it is well

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recognized by the fowl. Every club should see that this idea is put into practice, for it cannot help being an ultimate benefit to the membership as well as to the game.

It may not be necessary to go into the subject of illegal practices, but we are going to mention a few of these. The use of gasoline boats has already modified the habits of wild-fowl. Diving ducks of many species, especially Scoters, Eiders, and Ruddy Ducks, are almost at the mercy of very fast boats run down wind upon them at thirty or forty miles an hour. The Federal law has wisely forbidden shooting from power craft of all sorts, but persecution of wild-fowl from fast boats continues to be a serious menace. Airplanes, of course, have the same potentiality for harm and have likewise been banned as vehicles to shoot from.

Where airplanes are flown constantly, there has been a serious falling-off in the numbers of 'tending' ducks and geese, as in some of our Eastern harbors. As time goes on, all wild-fowl will, we think, more or less accommodate themselves to the presence of these winged monsters, once they have learned that they are harmless. This is the case now on the Potomac River after the birds have been settled for a few weeks.

There are many legal methods of taking ducks which are nevertheless reprehensible. In some of the 'slaughter-pens' of the Illinois bottoms they sometimes practice a system called 'trenching.' This consists in arranging a box so that several narrow lanes of open water radiate out from it. These lanes are heavily baited and the gunners so hidden that they can bide their time until a large number of Mallards have collected in the converging lanes, when the leader gives

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the signal and a murderous fire of automatics is poured down each 'trench.' Systematized slaughter is usually carried on in connection with wholesale game bootlegging and commercialization connected with the business of providing for visiting sportsmen. For instance, there has been recently developed a considerable illegal mail-order business in smoked ducks which will keep a long time and when shipped by parcel post are difficult to detect.

So many ducks shot in the United States are bred north of our boundary that it ill behooves us to make any complaint about spring and summer shooting carried on by native hunters in the far North. The Canadian Government has done rather more than its share already in setting aside sanctuary areas. Besides, we must not forget that their season is necessarily much shorter than ours. They have already shown their disapproval of the automatic shotgun by banning its use in some Provinces.

The taking of wild-fowl in Mexico has been until recently more of a business proposition than anything else. The owners of large haciendas in the neighborhood of Mexico City have employed destructive methods of supplying themselves with ducks. These 'armadas' or batteries of guns, set up to cover a certain favorite feeding ground, are touched off by one fuse in the hands of a concealed operator and the spoil so taken is carried to market. But we must be careful not to blame the Mexicans for the falling-off of our duck supply, because it seems probable that little over twenty-five per cent of North American game ducks go south of our boundary.

And now that we have made a brief survey of the

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subject of duck-killing methods, we must refer again to the repeating gun. When we closed our markets to the sale of migratory game birds, we, by so doing, took such birds from the category of market products and added them to the Nation's general treasure-house of wild-life resources. They immediately became a recreational asset rather than an economic one. Therefore, we maintain that they should be treated in this new light when their taking becomes the subject for regulations.

Unfortunately, the present mania for speed and complex machinery has made the repeating gun exceedingly attractive to a large class of shooters who appear to have become fascinated with the machine rather than with the gun. This has led, as we have remarked in another place, to a dependence upon 'bar-rage' fire to take the place of the skill of the old-time practiced shooter. The standard of accuracy is thus lowered and the percentage of crippled birds enormously raised.

The temptation to misuse a repeating gun is too great in the hands of the ordinary mortal, who is, we regret to admit, a human animal first and a sportsman afterwards. We would all be ultimately better off if the repeating gun could be reduced to a two-shot basis, which is quite sufficient for legitimate recreation and quite deadly enough to satisfy the killing impulse.

Another important factor should be mentioned in closing this chapter on shooting methods. The new superclass sporting powders have somewhat increased the range at which game may be cleanly killed and this fact has been seized upon by the trade as an important talking point in selling ammunition. The result has



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been a very much exaggerated idea among shooters as to the increased range of their new loads, which leads, we believe, to a still more reckless use of shells at barely possible to impossible ranges. And so a still larger percentage of birds go off hit, to perish later and become the food for marsh vermin.

Let us not make the mistake of losing the opportunity of doing everything possible to educate sportsmen up to the value of wild-life as a recreational asset. The pleasure to be derived from increased skill in the use of the ordinary double gun will far outweigh any dubious thrills which the modern shooter gets from the operation of machine guns. Such instruments are for use in desperate circumstances along with poison gas and torpedoes. We should see that they are reserved for such emergencies.

THE END.

## APPENDIX



## APPENDIX

### NORTH AMERICAN GAME WATERFOWL THEIR COMMON NAMES AND RANGES, WITH SOME NOTES ON THEIR PRESENT STATUS AND THEIR BODY WEIGHTS

#### SUBFAMILY CYGNINÆ — SWANS

##### WHISTLING SWAN (*Cygnus columbianus*)

*Other names:* Swan, American Swan, Cygne Sauvage, etc.

*Breeding range:* Arctic Coast and islands west of Hudson Bay to Alaska.

*Winter range:* Mostly on Atlantic Coast, in Maryland, Virginia, and North Carolina. A few on the Gulf Coast and also on the Pacific Coast to California.

*Status:* This swan is probably holding its own with protection to-day. There are about 16,000 on the Atlantic Coast. A good many die of lead poisoning from eating shot in the marshes of Currituck, and some are being killed by oil.

*Weight:* 12 to 18 or 20 pounds; specimens over 20 pounds are probably Trumpeter Swans.

##### TRUMPETER SWAN (*Cygnus buccinator*)

*Other names:* Bugler, Whooper Swan.

*Breeding range:* Interior of western North America, formerly south to Central Plains States. Now much reduced and confined to Northwestern States (rarely) and to British Columbia.

*Winter Range:* Western United States and British Columbia, south rarely to Gulf of Mexico.

*Status:* This swan is now very rare and confined to a few localities where it appears to remain localized nearly the year around.

*Weight:* Probably up to 25 or 28 pounds. Much greater weights have been reported.

#### SUBFAMILY ANSERINÆ — TRUE GEESE

##### LESSER SNOW GOOSE (*Chen hyperborea*)

*Other names:* Brant, White Brant, Wavy, White Wavy.

*Breeding range:* From northern Alaska east to Baffin Island and on other Arctic Islands. Probably also breeds in eastern Siberia.



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*Winter range:* Mainly on coasts of Texas and in California and Mexico. Also along Louisiana coast. Rare on the Atlantic Coast. Occurs on Asiatic coast south to Japan.

*Status:* These are perhaps the most numerous of all the geese, and being shy and not very good eating, they are not pursued as constantly as the Canada Goose tribe. They are probably the commonest geese in California and in Texas.

*Weights:* Males,  $4\frac{3}{4}$  pounds to a little over 6 pounds. Females, 4 pounds to 5 pounds.

### GREATER SNOW GOOSE (*Chen atlantica*)

*Other names:* Same as last species.

*Breeding range:* Not well known. Northern Greenland certainly, and perhaps Ellesmere Land, Grinnell Land, and Grant Land. Possibly Devon Isle and Bylot Isle.

*Winter range:* Almost entirely on the beaches of Virginia and North Carolina. Birds from farther south are more likely to belong to the Lesser Snow species.

*Status:* There are probably about 5000 to 8000 of these birds on the Atlantic Coast. Not many are shot, but the development of beach resorts may in time interfere with their feeding grounds. A number are killed on passage along the St. Lawrence River below Quebec between St. Joachim and La Battevre Islands.

*Weights:* Males, from about 6 pounds to 8 pounds. Females, up to  $6\frac{1}{2}$  pounds. These geese average about one third heavier than the Lesser Snow.

### BLUE GOOSE (*Chen caerulescens*)

*Other names:* Blue Wavy, Blue Brant, Brant, Gray Brant, White-headed Goose, etc.

*Breeding range:* So far as known entirely confined to western Baffin Island. Only recently discovered actually breeding.

*Winter range:* Practically confined to the coast of Louisiana from the Delta country to the Texas border; becoming much scarcer along the coast of Texas where it is replaced by the Lesser Snow Goose.

*Status:* Still a very abundant species, little disturbed on its breeding grounds and greatly benefited by great preserves on the coast of Louisiana. There may be two or three hundred thousand of this species in existence.

*Weights:* Same as Lesser Snow Goose. We have been told that the white-bellied specimens, which may be hybrids between Blue-Geese and Lesser Snow, are a little heavier than the true Blue Goose.

### ROSS GOOSE (*Chen rossii*)

*Other names:* China Goose, Little Wavy, Ross's Snow Goose, Horned Wavy.

*Breeding range:* Unknown, but probably the far northern islands of the western Arctic.

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*Winter range:* Almost entirely confined to California, where it is now reduced in numbers and deserving of special protection. Within the State there are probably wintering flocks of 5000 to 10,000, distributed mostly in the lower Sacramento and southern San Joaquin Valley. They are easy to count when they first arrive from the North, but later they split up and mix with Lesser Snow Geese so that their numbers are hard to estimate. The very limited winter range, in a region which is rapidly being given over to intensive cultivation and settlement, renders the future of this species rather uncertain. They were formerly much more abundant, but always, as now, much scarcer than the Lesser Snow Goose.

*Weights:* Average about  $3\frac{1}{4}$  pounds. Males,  $2\frac{3}{4}$  pounds to  $3\frac{3}{4}$  pounds. Females,  $2\frac{1}{4}$  pounds to  $3\frac{1}{8}$  pounds.

### WHITE-FRONTED GOOSE (*Anser albifrons albifrons*)

*Other names:* Brant, Speckle-belly, Checker-belly, Laughing Goose, Gray Goose, California Goose, Mottled Brant, etc.

*Breeding range:* Arctic coast or near it from northeastern Siberia, east to northeastern Mackenzie (Anderson River). Also in Greenland, Iceland, and Arctic Europe and Asia. The range is almost circumpolar.

*Winter range:* In western United States and in Mexico, north to southern British Columbia. In Eastern Hemisphere to Japan, China, India, and the Mediterranean countries.

*Status:* Still an abundant species, although reduced in numbers in recent years. Ranks about fourth in order of abundance among California geese.

*Weights:* Males,  $4\frac{1}{2}$  pounds to  $5\frac{1}{2}$  pounds. Females, 3 pounds to  $4\frac{1}{4}$  pounds. (Weights up to  $6\frac{1}{2}$  pounds are on record.)

### TULE GOOSE (*Anser albifrons gambelli*)

*Other names:* None except as above.

*Breeding range:* Unknown, but probably near Arctic coast east of Anderson River.

*Winter range:* Mainly in Sacramento Valley of California. Most of them appear to winter around Butte Creek Basin, where the land is almost entirely taken up by shooting clubs. A few may be found on the Suisun Marsh, Solano County.

*Status:* Now very scarce, indeed. Some authorities think this form of the White-fronted Goose is, or soon will be, extinct.

*Weights:* Males, probably up to  $7\frac{1}{2}$  pounds. Females, up to 6 pounds.

### PINK-FOOTED GOOSE (*Anser brachyrhynchus*)

*Breeding range:* Spitzbergen and probably other parts of Arctic Europe.

*Winter range:* Northern Europe and western Europe generally. A very rare straggler to the northeastern United States. (Massachusetts.)

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### CANADA GOOSE (*Branta canadensis*)

*Other names:* Honker, Canada Honker, Wild Goose, Big Wild Goose, Gray Goose.

*Breeding range:* Canada, south of the true Barren Grounds from Newfoundland and Labrador, west to British Columbia, and south formerly all over our Northern Plains States to northern Utah and to Tennessee and Arkansas. Now rare in most parts of its former range in the United States, but still breeding in some places, such as the Bear River Marshes in northern Utah.

*Winter range:* On east coast from southern Nova Scotia to Florida and all over the southern United States and Gulf Coasts. Also northern Mexico, as well as parts of the warmer interior valleys of the Rocky Mountain States and southern British Columbia.

*Status:* Has undoubtedly become scarcer throughout the interior of the country, but has held its own remarkably well on the Atlantic Coast and even perhaps increased in the past two decades. It shows great adaptation to changed conditions and there is little likelihood that it will be in any danger by the hand of man for years to come.

*Weights:* Males — It is quite certain that weights over 12 pounds are very unusual, the average being 9 pounds or less. Very much greater weights have been recorded, and we may feel fairly certain that reliable observers have recorded weights of 13 to 15 pounds. It appears likely that a geographical race of large size once inhabited the northern prairies, for much heavier birds are recorded from this region. This breeding stock is now extirpated. We are inclined to regard weights over 14 pounds with some doubt, and any weight over 12 pounds as very remarkable among ordinary migrant stock. Females, up to about 10¼ pounds, but rarely over 8 or 9 pounds.

### HUTCHINS GOOSE (*Branta canadensis hutchinsii*)

*Other names:* Same in a general way as those applied to the Canada Goose, from which it can be told only by its smaller size.

*Breeding range:* More western and northern than that of the Canada Goose. From northern Alaska across the Barren Grounds to Southampton Island and west coast of Hudson Bay. East to Baffin Island. Probably intergrades with the Cackling Goose in Alaska and with the Canada Goose in northern Canada.

*Winter range:* Western United States and east regularly to the Mississippi Valley. Also in Mexico, Lower California, and north to northern Washington. Very rare on Atlantic Coast.

*Status:* Satisfactory. It is probably third in order of abundance of the geese wintering in California, being exceeded only by the Cackling and Lesser Snow geese. Abundant on Gulf Coast.

*Weights:* Males, 4½ pounds to 7 pounds or a little over. Specimens over 7 pounds are more likely to be small Canada Geese or intergrades difficult to determine. However, weights of over 7 pounds have been



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recorded in specimens from Yukon Territory. There is a great deal of variation in the size of this species. Females,  $3\frac{3}{4}$  pounds to 5 pounds or even more. Average probably about 4 pounds.

### WHITE-CHEEKED GOOSE (*Branta canadensis occidentalis*)

*Other names:* Not very different from other geese of the Canadensis group.

*Range:* This local dark-breasted form of the Canada Goose seems to be confined to the Pacific coast of Alaska and British Columbia from Prince William's Sound southward. It winters over the same region and wanders southward. It intergrades with the Cackling Goose on the north and on the east with the true Canada Honker.

*Status:* No accurate information. Being a coastal species and wintering well north, it is probably entirely safe.

*Weights:* About the same as the Canada Honker.

### CACKLING GOOSE (*Branta canadensis minima*)

*Other names:* Brant, Bullneck, Cackler, Crow Goose, Little Gray Goose, Yelper, Chornie Goose, Little White-cheeked Goose.

*Breeding range:* Bering Sea coast of Alaska and on the Aleutian Islands of western Alaska, north probably to Kowak River in West Alaska.

*Winter range:* Mostly in California, but also northward (rarely) to British Columbia.

*Status:* Apparently the most abundant species of goose in California, yet it is not nearly so abundant as twenty-five years ago. Early writers were inclined to put the Hutchins Goose at the head of the list in order of abundance. These little Cackling Geese decoy more readily than other geese, and therefore are more readily shot over live decoys. Flocks of 20,000 or more have been seen in recent years in the Sacramento Valley and there are many more in the San Joaquin Valley.

*Weights:* Males,  $2\frac{1}{2}$  pounds to 3 pounds 12 ounces; average a little over 3 pounds. Females,  $2\frac{1}{4}$  pounds to 3 pounds  $2\frac{1}{2}$  ounces; average about  $2\frac{3}{4}$  pounds. Weights greater than these probably do not represent the true Cackling Goose. Allan Brooks gives  $4\frac{1}{2}$  pounds as maximum weight for this species.

### COMMON BRANT (*Branta bernicla bernicla*)

*Other names:* Brant Goose, Eastern Brant, Eastern Sea Brant, White-bellied Brant, May Brant. In England this species is usually called Brent or Brent Goose.

*Breeding range:* Arctic regions of eastern North America, Greenland, and east to Arctic Europe. In North America west to about  $100^{\circ}$  or  $110^{\circ}$  W. and north to at least  $82^{\circ}$  of latitude on Arctic islands.

*Winter range:* Regularly from Cape Cod, Massachusetts, to southern Pamlico Sound, North Carolina. Very rarely south to Florida. In Europe



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from coast of Baltic and North Sea to France. Rarely to Mediterranean waters.

*Status:* Apparently slightly on the increase since spring shooting was stopped, and wintering much more commonly in New England than formerly. Protection in the spring was a great benefit to this goose.

*Weights:* Males,  $2\frac{1}{2}$  pounds to  $3\frac{1}{2}$  pounds. Rarely up to 4 pounds. Females, 2 pounds to 3 pounds or a little over. (Weights over 4 pounds, even up to  $4\frac{3}{4}$  are on record.)

### BLACK BRANT (*Branta bernicla nigricans*)

*Other names:* Pacific Brant, Black Sea Brant, Brant.

*Breeding range:* Western Arctic from Point Barrow, Alaska, east to about Anderson River and north to Melville Isle, Banks Land, etc. Westward to Siberia and the Taimyr Peninsula.

*Winter range:* Pacific Coast of United States from Vancouver Isle to the Lower California Peninsula (San Quentin Bay). In Asia south to Japan and northern China.

*Status:* We have no definite information as to whether or not this species is holding its own.

*Weights:* Same as the Eastern or common Brant.

### BARNACLE GOOSE (*Branta leucopsis*)

*Other names:* None in America.

*Breeding range:* Northeastern Greenland and other parts of Arctic Europe.

*Winter range:* Western Europe south to Spain and straggling to both coasts of Greenland, Ungava, Ontario, Quebec, Vermont, Massachusetts, New York, and North Carolina. Always to be regarded as a very rare species in North America.

*Weights:* Average about 4 pounds, but weights up to 6 pounds have been recorded.

### EMPEROR GOOSE (*Philacte canagida*)

*Other names:* Beach Goose, Painted Goose, White-headed Goose.

*Breeding range:* Northwestern coast of Alaska from north of the Kuskokwim River to the north side of the Seward Peninsula. Also on St. Lawrence Isle and the northeast coast of Siberia.

*Winter range:* Aleutian Isles and Alaskan Peninsula east to Bristol Bay, west to Commander Isles. A few stragglers to British Columbia, California, and Hawaii.

*Status:* Said to be less plentiful on its breeding grounds than formerly. This is one of the geese that is most easily driven into nets by natives before young are on the wing.

*Weights:* Males, 6 pounds to 7 pounds, or possibly  $7\frac{1}{4}$  pounds. Females, up to about  $6\frac{3}{4}$  pounds. We have only a few available weight records for this species.

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### SUBFAMILY DENDROCYGNINÆ, TREE DUCKS

#### BLACK-BELLIED TREE DUCK (*Dendrocygna autumnalis*)

*Other names:* Summer Duck, Black-bellied Whistling Tree Duck, Red-billed Whistling Tree Duck, Cornfield Duck, Long-legged Duck, etc.

*Range:* Practically confined to Mexico and Central America as far as Panama. A few wander to southern Texas, where they spend the summer and breed.

*Status:* It was formerly a very common bird in the markets of Brownsville, Texas. The development and drainage of Central America may eventually reduce it greatly in numbers.

*Weights:* We have no records.

#### FULVOUS TREE DUCK (*Dendrocygna bicolor*)

*Other names:* Greater Whistling Teal, Brown Tree Duck, Squealer, Summer Duck, Brown Vicissi. Also a wealth of local native names.

*Distribution:* In the United States, southern California, Arizona, Texas, and Louisiana, also most of Mexico, with stragglers to British Columbia. Also occurs in parts of South America and in Africa and India. Breeding nearly everywhere that it is found.

*Status:* In the United States common only in southern California.

*Weights:* No records available.

### SUBFAMILY ANATINÆ, SURFACE-FEEDING DUCKS

#### MALLARD (*Anas platyrhynchos*)

*Other names:* Wild Duck, Green Head, English Duck, French Duck, Stock Duck, etc.

*Breeding range:* Northern North America. Chiefly, however, in the West. From Northwestern Alaska to California and east to Lake Erie, north to west coast of Hudson Bay and to the Arctic Coast at the mouth of the Mackenzie.

*Winter range:* Wherever open water occurs from Alaska to Mexico and from Nova Scotia (rarely) to Florida. A slightly different race is resident in Greenland. The Mallard also breeds over all the northern and temperate portions of the Old World with the exception of the extreme Arctic regions.

*Status:* The Mallard has held its own better than many other species, since it is one of the most adaptable of all ducks and rapidly develops nocturnal habits as a result of persecution.

*Weights:* Males,  $2\frac{1}{2}$  pounds to  $3\frac{3}{4}$  pounds; average about  $2\frac{3}{4}$  pounds. Females, 2 pounds to  $2\frac{3}{4}$  pounds.

#### MEXICAN DUCK (*Anas diazi diazi*)

*Other names:* Diaz's Duck, Pato Triguero.

*Range:* Confined to the highlands of central Mexico. It is non-migratory.

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*Status:* The great amount of drainage that has been going on in Mexico and the destructive methods of shooting in the Valley of Mexico have certainly greatly reduced the numbers of this duck. It is not now a common species.

### NEW MEXICAN, OR HUBER'S DUCK (*Anas diazi novimexicana*)

*Other names:* None.

*Range:* New Mexico and probably also in Chihuahua, Mexico. Possibly also at times in Utah and in California. Little is known of this duck, which closely resembles the Mexican Duck.

*Status:* Everywhere a rare species and often confused with common Mallards (female and eclipse specimens) as well as with 'Black' Ducks.

*Weight:* Same as the Mallard.

### FLORIDA DUSKY DUCK (*Anas fulvigula*)

*Other names:* Florida Duck, Florida Black Duck, Brown Mallard, Summer Duck, Summer Mallard, Mottled Duck, Mexican Mallard, etc.

*Range:* Breeding and wintering in the peninsula of Florida and the Gulf Coast regions of Florida, Alabama, Mississippi, Louisiana, and Texas. Often confused with the northern migratory Black Duck.

*Status:* Reduced greatly in numbers in Florida, but probably holding its own on the coast of Louisiana. The Gulf Coast marshes may in the near future be ruined by the presence of oil wells, which have already done much damage in parts of Texas. This species might be endangered by pollution from oil, since its range is strictly limited.

*Weights:* Slightly less than the Mallard and Black Duck.

### BLACK DUCK (*Anas rubripes*)

*Other names:* Dusky Duck, Black Mallard, Black Stock Duck, Red-legged Black Duck, Winter Black Duck.

*Breeding range:* Essentially an Eastern species occupying those parts of North America east of the range of the Mallard. From the James Bay region this duck breeds across Labrador, except northern Ungava and all over the Maritime Provinces of Canada, the northeastern United States, as far south as Dare County, North Carolina, on the coast.

*Winter range:* From southern Nova Scotia to northern Florida and in the Mississippi Valley and Gulf Coasts of the United States. Apparently extending its range westward across our northern tier of States.

*Status:* This duck probably exists more nearly in its primitive abundance than any species of game duck in North America. The unsettled conditions of most of the breeding range accounts for this happy result. The greatest danger to the species will undoubtedly come from oil pollution in coastal waters, and already this curse of oil has killed many Black Ducks in our northeastern States in winter.

*Weights:* Males,  $2\frac{1}{2}$  pounds to  $3\frac{3}{4}$  pounds. Average of adult males in late autumn sometimes as high as 3.2 pounds, but usually the average

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will be under 3 pounds. Females,  $2\frac{1}{4}$  pounds to nearly 3 pounds. Heavier specimens are on record (3.4 pounds).

### GADWALL (*Anas strepera*)

*Other names:* Gray Duck, Speckle-belly, Prairie Mallard, Creek Duck, Gray Widgeon, Welsh Duck, Sand Widgeon, Gadbill.

*Breeding range:* Western United States and Canada from the Pacific Coast to Lake Michigan, north to Lake Athabaska and south to California and Utah. A common species in the Old World.

*Winter range:* On the Pacific Coast from Vancouver Island to California and Mexico. Rare on the eastern coast of North America north of Virginia; and not abundant anywhere east of the Mississippi Valley.

*Status:* There is no reason to suppose that this species has decreased out of proportion to its numbers. It is not so wary a duck as the Mallard or the Pintail, so that it is possible that it will not hold its own so well as these commoner species. Its main stronghold is on the Gulf Coast of Texas. The fact that it is not a far-Northern breeding species may result in a serious loss in numbers in the future owing to the progress of agriculture and drainage.

*Weights:* Males, 2 pounds to 2 pounds 6 ounces. Females, about 2 pounds.

### FALCATED TEAL (*Anas falcata*)

*Other names:* Crested Teal, Bronze-capped Teal.

*Breeding range:* Eastern Asia.

*Winter range:* To Japan, Korea, southern China, Burma, and India. Included among North American ducks on the basis of a specimen taken on St. George's Isle, Pribilof group, in 1917. Also found on the Commander Isles.

### EUROPEAN WIDGEON (*Anas penelope*)

*Other names:* Widgeon, Red-headed Widgeon, Whistler, Half-duck, Whim, Smee Duck, Norwegian Widgeon.

*Breeding range:* Northern parts of the Old World to well beyond the Arctic Circle and in Iceland.

*Winter range:* From Europe and North Africa to India, China, and Japan.

In North America this widgeon straggles to south and west Greenland, Labrador, and Nova Scotia and down the whole East Coast to Florida. Also there are a number of inland records, and it is far from rare on the Pacific Coast. From the capture of at least three European Widgeon on our East Coast, that were banded in Iceland, it now appears likely that all our Eastern specimens come from that source.

*Status:* In North America not apparently as common as twenty or thirty years ago. Certainly not on the East Coast.

*Weight:* Males,  $1\frac{3}{4}$  pounds to 2 pounds, or a trifle over at times. Females, nearly half a pound less than the male.



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### AMERICAN WIDGEON (*Anas americana*)

*Other names:* Baldpate, Bald-faced Widgeon, Bald-crown, Baldy, Southern Widgeon, Green-headed Widgeon, White-bellied Duck, Smoking Duck.

*Breeding range:* Western Canada and Alaska from the Arctic Coast to the northern prairie States, and rarely to Utah and New Mexico. Much more abundant in the northern parts of its range.

*Winter range:* The whole Pacific Coast from British Columbia to Central America and the Gulf and Atlantic Coasts. North rarely as far as Massachusetts. Also to Cuba.

*Status:* The outlook for this species is rather favorable, for Widgeon are clever birds and are apt to stay in large packs. Often they are mixed with Pintails, which are even shyer birds than these. Their far-Northern breeding range is another very favorable factor in maintaining goodly numbers.

*Weights:* Males, 2 pounds to 2 pounds 7 ounces; average a little over 2 pounds for birds in good condition. Females, 1 pound 8 ounces to 2 pounds; average of adults, 1 pound 12 ounces.

### EUROPEAN TEAL (*Anas crecca*)

*Other names:* Teal, Common Teal.

*Range:* Europe and Asia, migrating to southern Europe, Asia, North Africa, China, and Japan. In North America it is a very rare bird on the East Coast from Labrador to Virginia. It also occurs rarely in Greenland.

### AMERICAN GREEN-WINGED TEAL (*Anas carolinensis*)

*Other names:* Teal, Green-wing, Northern Teal, etc.

*Breeding range:* Western and northwestern America from western Alaska to the mouth of the Mackenzie and eastward to Illinois and Wisconsin; south to California. A rare breeder east to Labrador.

*Winter range:* From British Columbia to Mexico and Honduras and across the southern United States to the East Coast. Also in the West Indies and Bahamas.

*Status:* The center of abundance is in the West and on the Gulf Coast. As all ducks in the Rocky Mountain States have greatly decreased in the past ten or fifteen years, this species has no doubt also diminished. In the East they have held their own better than the Blue-wing.

*Weights:* Males, about  $\frac{3}{4}$  pound or a little over at times. Females, 10 or 11 ounces.

### FORMOSAN TEAL (*Anas formosa*)

*Other names:* Baikal Teal, Spectacled Teal, Japanese Teal.

An Asiatic species that has been taken once at Wainwright, Alaska, and also in Clallum County, Washington.

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### BLUE-WINGED TEAL (*Anas discors*)

*Other names:* Blue-wing, Summer Teal, etc.

*Breeding range:* Central United States and prairie Provinces of Canada, to about Athabaska Lake. East to Lake Erie and rarely on the Magdalen Isles and in Maryland. In the Mississippi Valley south to the coast of Louisiana.

*Winter range:* More southern than any other true North American duck, extending to the West Indies, Central America, and the northern and northwestern parts of South America. Stragglers have been taken in Peru and Chile.

*Status:* Undoubtedly has decreased very much in the past fifty years, especially on the Atlantic Coast. It has also decreased greatly in the Mississippi Valley. In places there has been a considerable increase in the breeding stock since the protection afforded by the Federal law of 1913. The southern breeding range, the tameness of these little ducks, and their excellent table qualities have been a severe handicap.

*Weights:* Males, 12 to 15 ounces, or a little more. Females, 10 to 13 ounces.

### CINNAMON TEAL (*Anas cyanoptera*)

*Other names:* Red-breasted Teal, Red Teal, Blue-winged Teal, Raffles' Teal.

*Breeding range:* Western North America, chiefly west of the Rockies from southern British Columbia to Mexico. Also breeds over most of southern and western South America from the Guianas and Colombia to Argentina and Chile.

*Winter range:* In North America, not well known. Most of them may go to Central and South America, while a very few winter in Mexico and even in California.

*Status:* Once one of the most abundant of the breeding ducks in our Western and Southwestern States. Still a very common duck, but much of its former range in the Rocky Mountain States has been spoiled by drainage and cultivation. As it leaves very early in the fall, comparatively few are shot nowadays.

*Weights:* Males, 14 ounces to a little over a pound. Females, somewhat smaller.

### SHOVELER (*Spatula clypeata*)

*Other names:* Spoonbill, Spoony, Broadbill, Blue-wing Shoveler, Mud Duck, Cowan, Cow-frog, Shovelard, etc.

*Breeding range:* Western United States and western Canada from Alaska to California and east to Lake Michigan. Probably not a common breeder north of Athabaska Lake. Also a common species in the Old World.

*Winter range:* To Mexico, Central America, and West Indies, straggling even farther south to Colombia and to the Hawaiian Isles. Not abundant on Atlantic Coast in winter.

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*Status:* Most abundant on Gulf Coast of Louisiana and Texas. Has, like all other ducks, greatly decreased in California. Its confiding nature and relatively southern breeding range are factors working against it. However, its poor table qualities and small size are in its favor.

*Weights:* Males, 1 pound 4 ounces to 1 pound 10 ounces. Females, 1 pound 2 ounces to 1 pound 4 ounces; possibly more at times.

### PINTAIL (*Anas acuta*)

*Other names:* Sprig, Sprig-tail, Gray Duck, Pheasant or Pheasant Duck, Split-tail, Spike-tail, Pike-tail, Long-neck, Spindle-tail, etc.

*Breeding range:* In North America very extensive; all of Alaska and the Arctic Barren Lands west of Hudson Bay to the northern prairie States and to California. East to Lake Erie. In the Old World, from Iceland to East Siberia.

*Winter range:* From southeastern Alaska all the way to Panama and on the Atlantic Coast north commonly to Virginia and Maryland.

*Status:* This and the Mallard are the two most abundant game ducks and this species has probably decreased less than any other in recent years. Its high Northern breeding range and extreme wariness are all in its favor.

### BAHAMA DUCK (*Anas bahamensis*)

*Other names:* Bahama Pintail, Pato Criollo, Pato de Orillo, Pato de Rio, etc.

*Range:* This is a non-migratory species taken only twice on the mainland of North America, namely, at Cape Canaveral, in Florida, and at Lake Winneconne, Wisconsin. It is common in the Bahamas and West Indies and also in eastern South America.

### WOOD DUCK (*Aix sponsa*)

*Other names:* Summer Duck, Carolina Duck, Woody, Acorn Duck, Squealer, Tree Duck, Wood Widgeon.

*Breeding range:* Temperate North America, mostly east of the prairies from Nova Scotia and southern Ontario to Florida and Cuba. Resident over some parts of its range in the South. Also breeds in southern British Columbia and south to California, but not nearly so plentiful on Pacific Coast.

*Winter range:* In the southern parts of its breeding range. It does not migrate into Mexico.

*Status:* Once greatly reduced by summer shooting, especially in our Northern States, this fine duck has recovered everywhere with protection. Its early departure from our Northeastern States and Canada renders it fairly safe from overshooting. Increasing greatly in the Mississippi Valley.

*Weights:* Males, up to 1 pound 15 ounces; females, up to 1 pound 7 ounces.

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### SUBFAMILY NYROCINÆ, DIVING DUCKS

#### CANVAS-BACK (*Nyroca valisineria*)

*Other names:* White-back, Can, Red-neck, Bull-neck, Horse Duck, Sheldrake, etc.

*Breeding range:* Western and northern prairie region, north to Great Slave Lake and south to Nebraska and the Dakotas. The breeding range is not a very large one and drainage plus agriculture has greatly altered it for the worse.

*Winter range:* Chiefly the southern United States and Mexico. On Pacific Coast from Vancouver Isle to Lower California.

*Status:* This duck appears to be holding its own better than some of the other diving ducks, especially on the Atlantic Coast. Its high price in the market shooting days worked great havoc among the flocks. In California it is greatly reduced and on the Gulf Coast it is not as numerous as formerly.

*Weights:* Males, 2 pounds 8 ounces to 3 pounds 12 ounces; average of good birds about 3 pounds. Females, 2 pounds 8 ounces to about 3 pounds.

#### REDHEAD (*Nyroca americana*)

*Other names:* Raft Duck, Red-headed Raft Duck, American Pochard, Red-headed Broadbill, Fool Duck, Fiddler, etc.

*Breeding range:* Confined to the prairies of Canada and the Western States from Lake Athabaska to Utah and California, east to Minnesota and Wisconsin and west to southern British Columbia.

*Winter range:* Southern British Columbia to southern Mexico and on the Atlantic Coast north to Long Island, New York. Casual in the West Indies.

*Status:* Undoubtedly has decreased to a greater extent than any other game diving duck due to its breeding range being so greatly altered by drainage and agriculture and also by its very confiding disposition, especially on its breeding grounds.

*Weights:* 2 pounds 8 ounces to 3 pounds; average weight of fine winter males, 2 pounds 10 ounces. Females, 2 pounds to 2 pounds 9 ounces; average weights of winter specimens, about 2 pounds 4 ounces.

#### EUROPEAN POCHARD (*Nyroca ferina*)

A common duck of the Old World. Has been taken on the Pribilof Isles, Alaska.

#### TUFTED DUCK (*Nyroca fuligula*)

Has been taken on the Pribilof Isles. A common duck in western Europe.



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### RING-NECKED DUCK (*Nyroca collaris*)

*Other names:* Ring-necked Scaup, Ring-bill, Black Jack, Blackie, Bastard Broadbill, Black Duck, Creek Redhead, Mud Duck, Flock Duck, Morillon a collier, etc.

*Breeding range:* Rather more to the eastward than most other diving ducks. From Athabaska Lake to Wisconsin and to Arizona and California. Commonly in Manitoba and in Minnesota.

*Winter range:* Rare on Atlantic Coast except in some years, becoming common all over inland Florida and very plentiful on the Gulf Coast of Louisiana, especially in the lakes near the coast. Also along the Texas coast. Reaches also to the West Indies, Mexico, and Guatemala.

*Status:* On account of its southern breeding range, this species has decreased greatly in abundance. There seems to be a tendency for it to be commoner on the middle Atlantic Coast than it used to be. In only a few places is it a really abundant species.

*Weights:* Males, 1 pound 8 ounces to 1 pound 12½ ounces. Females, 1 pound 6 ounces to 1 pound 9 ounces.

### GREATER SCAUP DUCK (*Nyroca marila*)

*Other names:* Scaup, Common Scaup, Blue-bill, Big Blue-bill, Broadbill, Salt Water Broadbill, Blackhead, Raft Duck, Widgeon, etc. Most of these names are also applied to the Lesser Scaup.

*Breeding range:* Northern and western parts of North America, especially western Alaska, southeastward through the Mackenzie Valley to Great Slave Lake. Appears to be only a casual breeder south of this region. Also a common species in the northern parts of the Old World. Often confused with Lesser Scaup, both on the breeding and wintering ranges.

*Winter range:* The whole of the Pacific Coast to southern California, and the Atlantic Coast from Massachusetts to Florida, but rare in Southern waters and uncommon on the Gulf Coast.

*Status:* This duck may be on the increase. There is little reason why it should not prosper, since its breeding range is far North and its winter habitat mostly marine. Oil pollution is the one adverse factor that is likely seriously to affect this duck.

*Weights:* Males, 2 pounds 4 ounces to 2 pounds 10 ounces. Rarely 2 pounds 12 ounces; average of good winter birds, 2 pounds 5½ ounces. Females, 2 pounds to 2 pounds 5 ounces; average, 2 pounds 2 ounces.

### LESSER SCAUP (*Nyroca affinis*)

*Other names:* Little Blue-bill, Blue-bill, Marsh Blue-bill, Fresh-water Broadbill, Creek Blackhead, Little Blackhead, etc.

*Breeding range:* More extensive than that of the Greater Scaup. From Arctic Coast and eastern Alaska to the northern prairie States. Not a common breeder anywhere in the United States at the present time. Their presence in summer is often noted far south of their breeding

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range. The same is true of the Greater Scaup. Often confused with Greater Scaup on breeding grounds.

*Winter range:* More extensive than that of the Greater Scaup and more common in the interior of the Southern States. From southern British Columbia to Panama and from Massachusetts and the Great Lakes to the West Indies, and once in Ecuador. Not common in winter as far north as the favorite range of the Greater Scaup.

*Status:* Greatly reduced in numbers on Atlantic Coast and Florida. Possibly holding its own on the Gulf Coast and better than most species in California and the Pacific States generally. This is a tame duck and easily shot over decoys.

*Weights:* Males, 1 pound 8 ounces to 1 pound 14 ounces. Females, 1 pound 4 ounces to 1 pound 10 ounces.

### GOLDEN-EYE (*Bucephala clangula americana*)

*Other names:* Whistler, Whistle-wing, Whiffler, Bull-head, Bell-ringer, King-diver, Hell-diver, etc.

*Breeding range:* Wooded regions of North America from western Alaska to southern Labrador and Newfoundland. South to the northeastern United States. European race breeds from Scandinavia to Siberia.

*Winter range:* Coasts and interior from the Alaska peninsula to California and from the St. Lawrence Valley to northern Florida. Rare in Southern States and absent in Mexico.

*Status:* About the same as formerly.

*Weights:* Males, 2 pounds 6 ounces to 2 pounds 10 ounces. Females, 2 pounds to 2½ pounds.

### BARROW'S GOLDEN-EYE (*Bucephala islandica*)

*Other names:* Rocky Mountain Golden-eye, Rocky Mountain Whistler, Whistler, Arctic Garrot.

*Breeding range:* Southern Alaska through the mountains to Colorado. Also in west Greenland and Iceland.

*Winter range:* Pacific Coast and Rocky Mountain States. Also North Atlantic Coast (uncommon) as far south as Massachusetts.

*Status:* Abundant on Pacific Coast and in Iceland. Rather rare on Atlantic Coast and casual everywhere in the interior east of the Rockies.

*Weights:* Same as common Golden-eye.

### BUFFLE-HEAD (*Bucephala albeola*)

*Other names:* Butter-ball, Butter-box, Spirit Duck, Dipper, Didapper, Hell-diver, Marionette.

*Breeding range:* Alaska and northwestern America south to the United States. Common in the wooded regions of the Mackenzie Valley, becoming more rare north of Athabaska Lake. Again common on upper Yukon River and the wooded parts of Alaska.

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*Winter range:* The whole Pacific Coast to northern Mexico and the Atlantic Coast to northern Florida. Also abundant in lower Mississippi Valley and the Gulf Coast.

*Status:* No marked change in recent years.

*Weights:* Males, 15 ounces to 1 pound 3 ounces. Females, 15 ounces to 1 pound 2 ounces.

### SUBFAMILY OXYURINÆ, SPINY-TAILED DUCKS

#### RUDDY DUCK (*Oxyura jamaicensis*)

*Other names:* Ruddy, Booby, Booby Coot, Bumble-bee Coot, Butter-ball, Fool Duck, Deaf Duck, Bristle-tail, Sleepy Head, etc.

*Breeding range:* Western and central United States from about Athabaska Lake to California, Arizona, Utah, and Texas, and east as far as Minnesota and Kansas. Once found nesting in Massachusetts at Cape Cod. Also breeds in Cuba, Porto Rico, and the Lesser Antilles.

*Winter range:* Southern United States, West Indies, and Mexico, rarely to Panama, and possibly to Guiana.

*Status:* Greatly reduced, especially on Atlantic Coast. Its breeding range has been much affected and its very confiding disposition makes it an easy mark for every boy hunter.

*Weights:* Males, 1 pound 4 ounces to 1 pound 8 ounces. Females, less.

*Note:* This completes the list of the true game wild-fowl of North America. We have not thought it worth while to list the many species of sea-ducks and the mergansers, although the Hooded Merganser may be thought by some to rank as a game species.

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